
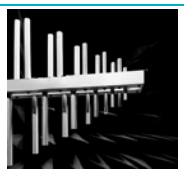
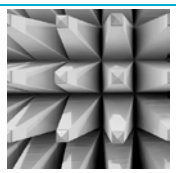

CTC advanced
member of RWTÜV group

Bundesnetzagentur

BNetzA-CAB-02/21-102

TEST REPORT

Test report no.: 1-2867/21-01-13

Testing laboratory

CTC advanced GmbH
Untertuerkheimer Strasse 6 – 10
66117 Saarbruecken / Germany
Phone: + 49 681 5 98 - 0
Fax: + 49 681 5 98 - 9075
Internet: https://www.ctcadvanced.com
e-mail: mail@ctcadvanced.com

Accredited Testing Laboratory:
The testing laboratory (area of testing) is accredited according to DIN EN ISO/IEC 17025 (2018-03) by the Deutsche Akkreditierungsstelle GmbH (DAkkS)
The accreditation is valid for the scope of testing procedures as stated in the accreditation certificate starting with the registration number: D-PL-12076-01.

Applicant

Sennheiser electronic GmbH & Co. KG
Am Labor 1
30900 Wedemark / GERMANY
Phone: +49 5130 600-0
Contact: Ouajdi Ochi
e-mail: Ouajdi.Ochi@sennheiser.com

Manufacturer

Sennheiser electronic GmbH & Co. KG
Am Labor 1
30900 Wedemark / GERMANY

Test standard/s

FCC - Title 47 CFR Part 74	FCC - Title 47 of the Code of Federal Regulations; Chapter I; Part 74 - Experimental radio, auxiliary, special broadcast and other program distributional services
RSS - 210 Issue 10	Spectrum Management and Telecommunications Radio Standards Specification - Licence-Exempt Radio Apparatus: Category I Equipment

For further applied test standards please refer to section 3 of this test report.

Test Item

Test item description:	**Bodypack Transmitter**
Model No.:	**EW-DX SK**
FCC ID:	**DMOSKEWD**
ISED certification number:	**2099A-SKEWD**
Frequency:	470 MHz to 608 MHz
Technology tested:	proprietary
Antenna:	internal monopole
Power supply:	2.50 V to 4.35 V DC by battery Li-Ion BA 70 or 2x AA type 1.50 V DC
Temperature range:	-10°C to +50°C

This test report is electronically signed and valid without handwritten signature. For verification of the electronic signatures, the public keys can be requested at the testing laboratory.

Test report authorized:

cn=Christoph Schneider, o=CTC advanced GmbH, ou=SND-211129, email=christoph.schneider@ctcadvanced.com, c=DE
2022.07.15 08:14:02 +02'00'

Christoph Schneider
Lab Manager
Radio Communications

Test performed:

cn=Tobias Wittenmeier, o=CTC advanced GmbH, ou=WIT-220519, email=tobias.wittenmeier@ctcadvanced.com, c=DE
2022.07.15 08:15:38 +02'00'

Tobias Wittenmeier
Testing Manager
Radio Communications

1 Table of contents

2 General information

2.1 Notes and disclaimer

The test results of this test report relate exclusively to the test item specified in this test report. CTC advanced GmbH does not assume responsibility for any conclusions and generalizations drawn from the test results with regard to other specimens or samples of the type of the equipment represented by the test item.
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In no case this test report can be considered as a Letter of Approval.

This test report is electronically signed and valid without handwritten signature. For verification of the electronic signatures, the public keys can be requested at the testing laboratory.

2.2 Application details

Date of receipt of order:	2022-02-22
Date of receipt of test item:	2022-04-01
Start of test:*	2022-04-04
End of test:*	2022-04-21
Person(s) present during the test:	-/-

*Date of each measurement, if not shown in the plot, can be requested. Dates are stored in the measurement software.

2.3 Test laboratories sub-contracted

None

3 Test standard/s, references and accreditations

Test standard	Date	Description
FCC - Title 47 CFR Part 74		FCC - Title 47 of the Code of Federal Regulations; Chapter I; Part 74 - Experimental radio, auxiliary, special broadcast and other program distributional services
RSS - 210 Issue 10	December 2019	Spectrum Management and Telecommunications Radio Standards Specification - Licence-Exempt Radio Apparatus: Category I Equipment
ETSI EN 300 422-1 V1.4.2	2011-08	Electromagnetic compatibility and Radio spectrum Matters (ERM); Wireless microphones in the 25 MHz to 3 GHz frequency range; Part 1: Technical characteristics and methods of measurement

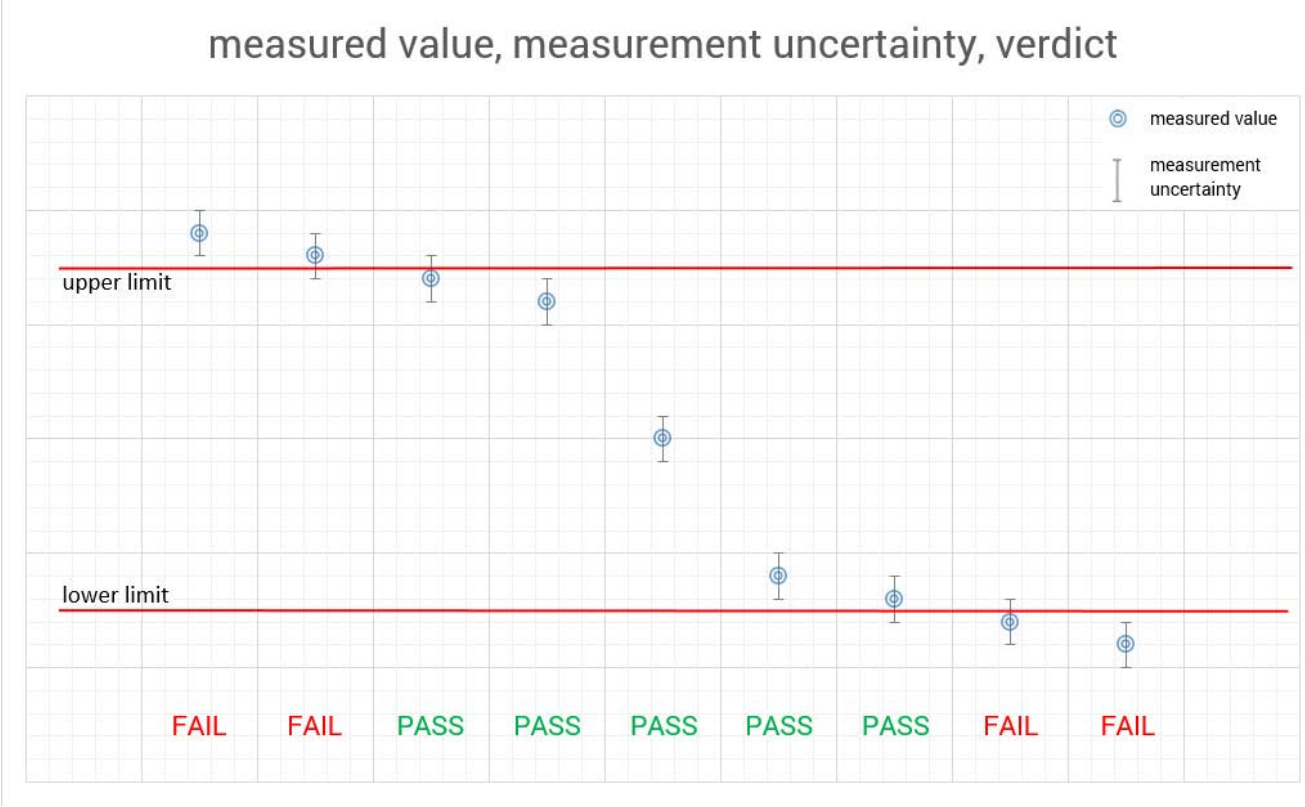
Guidance	Version	Description
ANSI C63.10-2013	-/-	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices

Accreditation	Description
D-PL-12076-01-04	Telecommunication and EMC Canada https://www.dakks.de/as/ast/d/D-PL-12076-01-04e.pdf
D-PL-12076-01-05	Telecommunication FCC requirements https://www.dakks.de/as/ast/d/D-PL-12076-01-05e.pdf

ISED Testing Laboratory Recognized Listing Number: DE0001
FCC designation number: DE0002

4 Reporting statements of conformity – decision rule

Only the measured values related to their corresponding limits will be used to decide whether the equipment under test meets the requirements of the test standards listed in chapter 3.
The measurement uncertainty is mentioned in this test report, see chapter 9, but is not taken into account - neither to the limits nor to the measurement results. Measurement results with a smaller margin to the corresponding limits than the measurement uncertainty have a potential risk of more than 5% that the decision might be wrong."



5 Test environment

Temperature	:	T_{nom} T_{max} T_{min}	+20 °C during room temperature tests +50 °C during high temperature tests -10 °C during low temperature tests
Relative humidity content	:		55 %
Barometric pressure	:		1021 hpa
Power supply	:	V_{nom} V_{max} V_{min}	3.80 V DC by battery Li-Ion BA 70 or 2x AA type 1.50 V DC 4.35 V 2.50 V

6 Test item

6.1 General description

Test item description	:	Bodypack Transmitter
Model No.	:	EW-DX SK
Brand name	:	SENNHEISER
Product name	:	Evolution Wireless Digital
HMN	:	-/-
PMN	:	EW-DX SK
HVIN	:	EW-DX SK
FVIN	:	0.7.0
S/N serial number	:	Rad. 470 MHz – 550 MHz: 1122000081 520 MHz – 608 MHz: 1122000040 Cond. 470 MHz – 550 MHz: 1122000077 520 MHz – 608 MHz: 1122000039
Hardware status	:	592160_03
Software status	:	-/-
Firmware status	:	0.7.0
Frequency band	:	470 MHz to 608 MHz
Type of radio transmission Use of frequency spectrum	: :	modulated carrier
Type of modulation	:	PI/4 DQPSK
Number of channels	:	Tuning step size: 25 kHz
Antenna	:	internal monopole
Power ratings	:	2.50 V to 4.35 V DC by battery Li-Ion BA 70 or 2x AA type 1.50 V DC
Operating temperature range	:	-10°C to +50°C

6.2 Additional information

The content of the following annexes is defined in the QA. It may be that not all of the listed annexes are necessary for this report, thus some values in between may be missing.

Test setup and EUT photos are included in test report:	1-2867/21-01-01_AnnexA 1-2867/21-01-01_AnnexB 1-2867/21-01-01_AnnexC

7 Description of the test setup

Typically, the calibrations of the test apparatus are commissioned to and performed by an accredited calibration laboratory. The calibration intervals are determined in accordance with the DIN EN ISO/IEC 17025. In addition to the external calibrations, the laboratory executes comparison measurements with other calibrated test systems or effective verifications. Weekly chamber inspections and range calibrations are performed. Where possible, RF generating and signaling equipment as well as measuring receivers and analyzers are connected to an external high-precision 10 MHz reference (GPS-based or rubidium frequency standard).

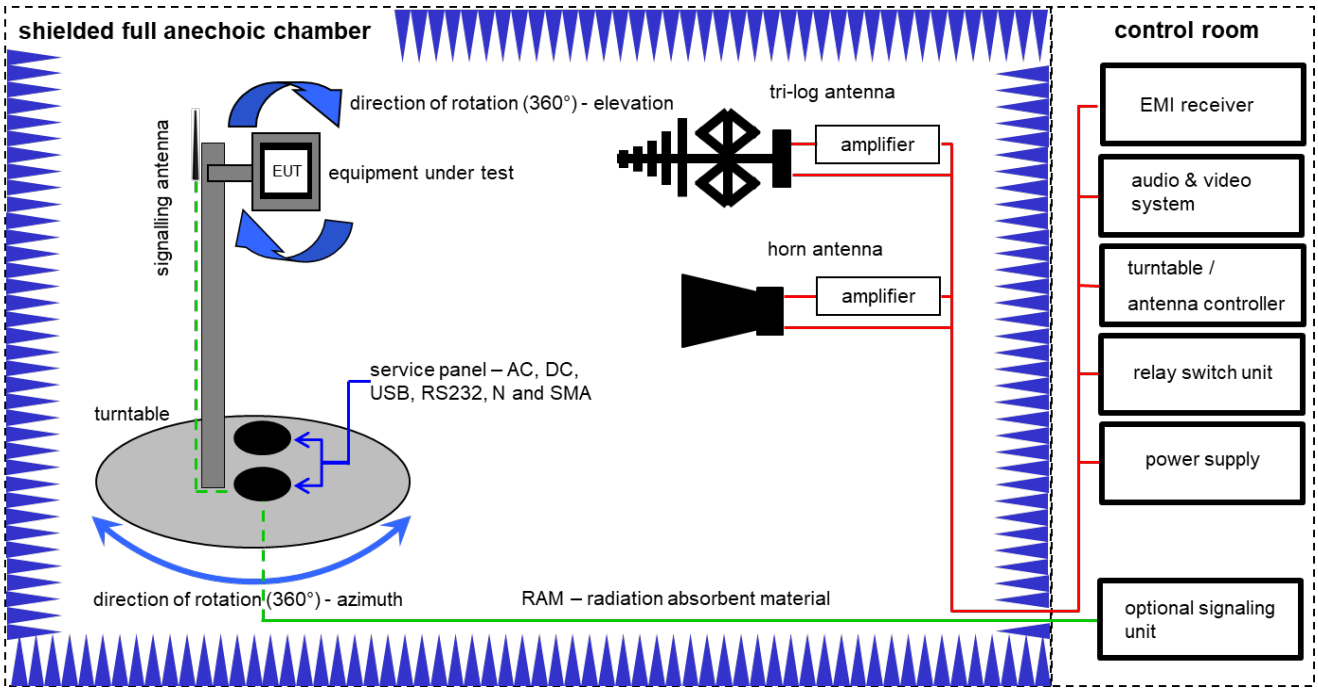
In order to simplify the identification of the equipment used at some special tests, some items of test equipment and ancillaries can be provided with an identifier or number in the equipment list below (Lab/Item).

Each block diagram listed can contain several test setup configurations. All devices belonging to a test setup are identified with the same letter syntax. For example: Column Setup and all devices with an A.

Agenda: Kind of Calibration

k	calibration / calibrated	EK	limited calibration
ne	not required (k, ev, izw, zw not required)	zw	cyclical maintenance (external cyclical maintenance)
ev	periodic self verification	izw	internal cyclical maintenance
Ve	long-term stability recognized	g	blocked for accredited testing
vlkl!	Attention: extended calibration interval		
NK!	Attention: not calibrated	*)	next calibration ordered / currently in progress

7.1 Shielded fully anechoic chamber



Measurement distance: tri-log antenna and horn antenna 3 meter

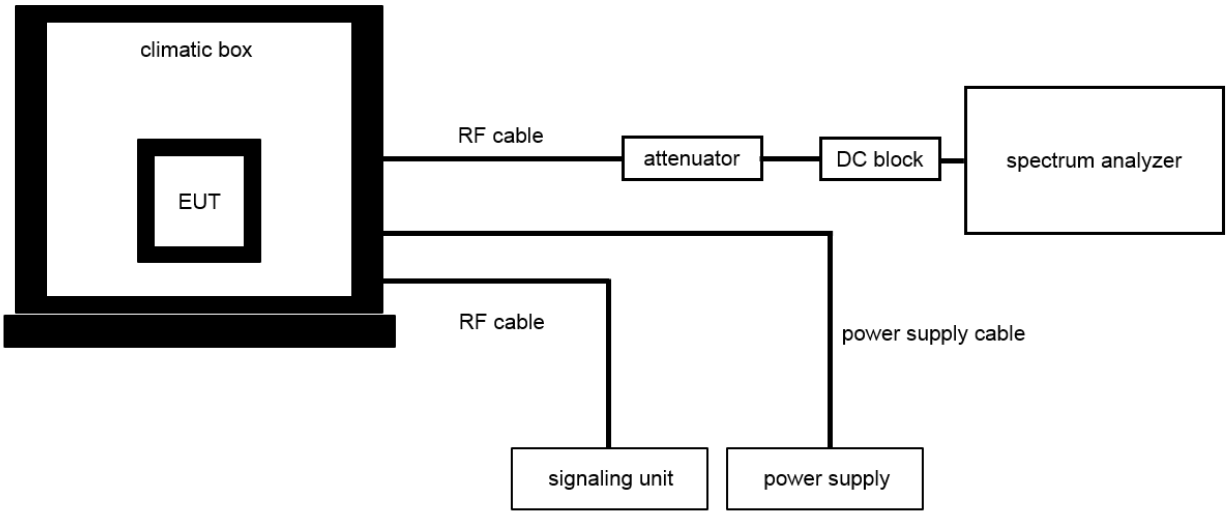
OP = AV + D - G + CA
(OP-radiated output power; AV-analyzer value; D-free field attenuation of measurement distance; G-antenna gain+amplifier gain; CA-loss signal path)

Example calculation:
OP [dBm] = -65.0 [dBm] + 50 [dB] - 20 [dBi] + 5 [dB] = -30 [dBm] (1 µW)

No.	Setup	Equipment	Type	Manufacturer	Serial No.	INV. No.	Kind of Calibration	Last Calibration	Next Calibration
1	A, B	Anechoic chamber	FAC 3/5m	MWB / TDK	87400/02	300000996	ev	-/-	-/-
2	A, B	Switch / Control Unit	3488A	HP	*	300000199	ne	-/-	-/-
3	B	Double-Ridged Waveguide Horn Antenna 1-18.0GHz	3115	EMCO	8812-3089	300000307	vIKI!	11.02.2022	29.02.2024
4	A, B	EMI Test Receiver 20Hz- 26,5GHz	ESU26	R&S	100037	300003555	k	09.12.2021	31.12.2022
5	B	Highpass Filter	WHK1.1/15G-10SS	Wainwright	3	300003255	ev	-/-	-/-
6	A	TRILOG Broadband Test-Antenna 30 MHz - 3 GHz	VULB9163	Schwarzbeck Mess - Elektronik	318	300003696	vIKI!	30.09.2021	29.09.2023
7	B	Broadband Amplifier 0.5-18 GHz	CBLU5184540	CERNEX	22049	300004481	ev	-/-	-/-
8	A, B	4U RF Switch Platform	L4491A	Agilent Technologies	MY50000037	300004509	ne	-/-	-/-
9	A, B	PC	ExOne	F+W		300004703	ne	-/-	-/-

7.2 Conducted measurements normal and extreme conditions

Conducted measurements normal & extreme conditions



OP = AV + CA
(OP-output power; AV-analyzer value; CA-loss signal path)

Example calculation:
OP [dBm] = 6.0 [dBm] + 11.7 [dB] = 17.7 [dBm] (58.88 mW)

Equipment table:

No.	Setup	Equipment	Type	Manufacturer	Serial No.	INV. No.	Kind of Calibration	Last Calibration	Next Calibration
1	A	Temperature Test Chamber	VT 4002	Heraeus Voetsch	521/83761	300002326	ev	12.05.2020	11.05.2022
2	A	Signal analyzer	FSW26	Rohde&Schwarz	101455	300004528	k	14.12.2021	31.12.2022
3	A	Power Supply	HMP2020	Rohde & Schwarz	102219	300006192	k	08.04.2021	07.04.2023

8 Sequence of testing

8.1 Sequence of testing radiated spurious 30 MHz to 12.75 GHz

Setup

- The equipment is set up to simulate normal operation mode as described in the user manual or defined by the manufacturer.
- If the EUT is a tabletop system, a 2-axis positioner with 1.5 m height is used.
- If the EUT is a floor standing device, it is placed directly on the turn table.
- Auxiliary equipment and cables are positioned to simulate normal operation conditions as described in ANSI C 63.4.
- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.
- Measurement distance is 3 m (see ANSI C 63.4) – see test details.
- EUT is set into operation.

Premeasurement

- The turntable rotates from 0° to 315° using 45° steps.
- The antenna is polarized vertical and horizontal.
- The antenna height is 1.5 m.
- At each turntable position and antenna polarization the analyzer sweeps with positive peak detector to find the maximum of all emissions.

Final measurement

- The final measurement is performed for at least six highest peaks according to the requirements of the ANSI C63.4.
- Based on antenna and turntable positions at which the peak values are measured the software maximizes the peaks by rotating the turntable from 0° to 360°. This measurement is repeated for different EUT-table positions (0° to 150° in 30°-steps) and for both antenna polarizations.
- The final measurement is done in the position (turntable, EUT-table and antenna polarization) causing the highest emissions with Peak and RMS detector (as described in ANSI C 63.4).
- Final levels, frequency, measuring time, bandwidth, turntable position, EUT-table position, antenna polarization, correction factor, margin to the limit and limit are recorded. A plot with the graph of the premeasurement with marked maximum final results and the limit is stored.

9 Measurement uncertainty

Measurement uncertainty	
Test case	**Uncertainty**
Transmitter output power	± 3 dB
Occupied bandwidth	± 3 kHz to 10 kHz (depends on the used RBW)
Transmitter frequency stability	± 1 Hz to 1 kHz (depends on the used RBW)
Transmitter unwanted emissions (radiated or conducted)	Radiated: ± 3 dB Conducted: ± 0.5 dB
Modulation characteristics	-/-
Necessary bandwidth (BN) for analogue systems	± 1 kHz (depends on the used RBW)
Frequency modulation	± 3 kHz (depends on the used RBW)
Spurious emissions conducted below 30 MHz (AC conducted)	± 2.6 dB

10 Summary of measurement results

☒	No deviations from the technical specifications were ascertained
☐	There were deviations from the technical specifications ascertained
☐	This test report is only a partial test report. The content and verdict of the performed test cases are listed below.

TC Identifier	Description	Verdict	Date	Remark
RF-Testing	FCC Part 74 RSS - 210, Issue 9 RSS-Gen Issue 4	See table!	2022-07-15	-/-

Test specification clause	Test case	Temperature conditions	Voltage conditions	C	NC	NA	NP	Remark
FCC Part 74.861 (e)(1)(ii) FCC Part 2.1046) RSS-210 – G.3.1 RSS-Gen – 6.12	Transmitter output power	Nominal	Nominal	☒	☐	☐	☐	-/-
FCC Part 74.861 (e)(5) FCC Part 2.1049 RSS-210 – G.3.2 RSS-Gen – 6.6	Occupied bandwidth	Nominal	Nominal	☒	☐	☐	☐	-/-
FCC Part 74.861 (e)(4) FCC Part 2.1055 RSS-210 – G.3.3 RSS-Gen – 6.11	Transmitter frequency stability	Nominal	Nominal	☒	☐	☐	☐	-/-
		Extreme	Extreme	☒	☐	☐	☐	
FCC Part 74.861 (e)(6) FCC Part 74.861 (e)(7) RSS-210 – G.3.4 ETSI EN 300 422-1 v1.4.2 (2011-08)	Transmitter unwanted emissions (radiated or conducted)	Nominal	Nominal	☒	☐	☐	☐	-/-
FCC Part 2.1047	Modulation characteristics	Nominal	Nominal	-/-				Digital modulation
FCC Part 74.861 (e)(7) ETSI EN 300 422-1 v1.4.2 (2011-08)	Necessary bandwidth (BN) for analogue systems	Nominal	Nominal	☒	☐	☐	☐	-/-
FCC Part 74.861 (e)(3) RSS-210 – G.3.5.2	Frequency modulation	Nominal	Nominal	☐	☐	☒	☐	Digital modulation
FCC Part 74.861 (e)(7) RSS-210 – G.3.4	Receiver spurious emissions	Nominal	Nominal	☐	☐	☒	☐	No receiver integrated!
FCC Part 15.107(a) FCC Part 15.207	Conducted emissions < 30 MHz	Nominal	Nominal	☐	☐	☒	☐	-/-

Note: C = Compliant; NC = Not compliant; NA = Not applicable; NP = Not performed

11 Additional comments

Reference documents: None

Special test descriptions: None

Configuration descriptions: None

Test mode:

☒ No test mode available.
Test signal is applied to the transmitter.

☐ Special software is used.
EUT is transmitting pseudo random data by itself

Antennas and transmit operating modes:

☒ Operating mode 1 (single antenna)

- *Equipment with 1 antenna,*
- *Equipment with 2 diversity antennas operating in switched diversity mode by which at any moment in time only 1 antenna is used,*
- *Smart antenna system with 2 or more transmit/receive chains, but operating in a mode where only 1 transmit/receive chain is used)*

☐ Operating mode 2 (multiple antennas, no beamforming)

- *Equipment operating in this mode contains a smart antenna system using two or more transmit/receive chains simultaneously but without beamforming.*

☐ Operating mode 3 (multiple antennas, with beamforming)

- *Equipment operating in this mode contains a smart antenna system using two or more transmit/receive chains simultaneously with beamforming.*
  In addition to the antenna assembly gain (G), the beamforming gain (Y) may have to be taken into account when performing the measurements.

12 Measurement results

12.1 Transmitter output power

Measurement:

Measurement parameter	
Detector:	Peak (worst case) / Average (RMS)
Sweep time:	Auto / 20s
Resolution bandwidth:	> emission bandwidth
Video bandwidth:	> resolution bandwidth
Span:	> 2 times emissions bandwidth
Trace mode:	Max. hold
EUT configuration:	Peak: Unmodulated carrier RMS: Modulate the transmitter with a 2.5 kHz tone at a level 16 dB higher than that required to produce a frequency deviation of ± 75 kHz, or to produce 50% of the manufacturer's rated deviation, whichever is less.
Test setup:	See sub clause 7.2 – A
Measurement uncertainty:	See sub clause 9

Limits:

FCC (conducted)	
470 MHz to 608 MHz	250 mW (average) / 24 dBm (average)
IC (e.i.r.p.)	
470 MHz to 608 MHz	250 mW (average) / 24 dBm (average)

Result normal mode:

Transmitter output power conducted / dBm						
Channels	**Q1-9**			**R1-9**		
Frequencies / MHz	**470.2**	**510.0**	**550.0**	**520.0**	**564.0**	**607.8**
Peak	12.90	13.29	13.70	12.76	13.11	13.48
Average	8.89	9.53	10.03	8.84	9.38	9.78

Transmitter output power e.i.r.p. / dBm						
Channels	**Q1-9**			**R1-9**		
Frequencies / MHz	**470.2**	**510.0**	**550.0**	**520.0**	**564.0**	**607.8**
Peak	13.85	15.95	14.70	13.75	15.75	14.43
Average	9.93	12.19	11.03	9.83	12.02	10.73

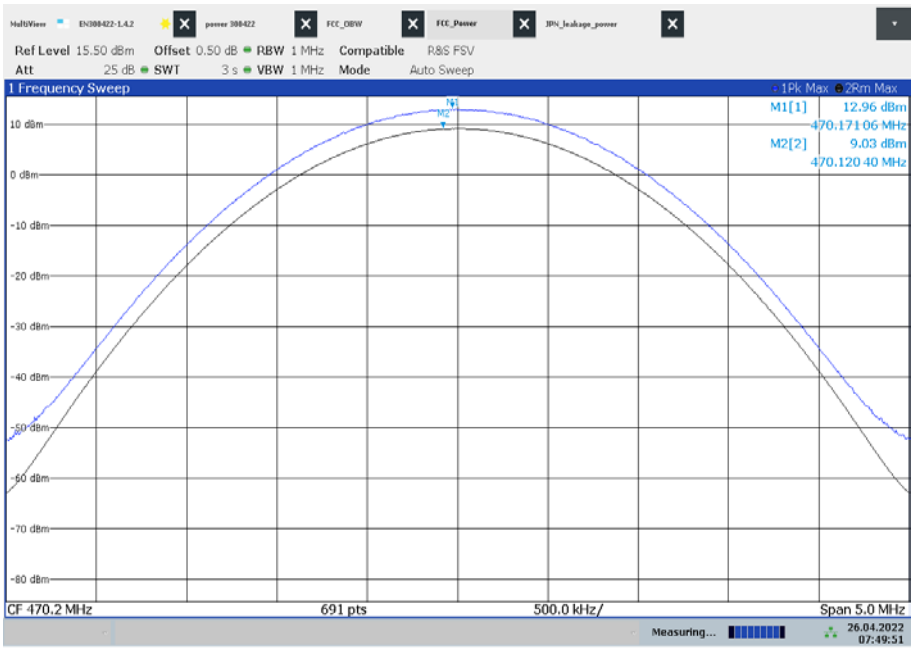
Result LD mode:

Transmitter output power conducted / dBm						
Channels	**Q1-9**			**R1-9**		
Frequencies / MHz	**470.2**	**510.0**	**550.0**	**520.0**	**564.0**	**607.8**
Peak	12.96	13.16	13.68	12.77	13.07	13.46
Average	9.03	9.50	10.07	8.81	9.35	9.82

Transmitter output power e.i.r.p. / dBm						
Channels	**Q1-9**			**R1-9**		
Frequencies / MHz	**470.2**	**510.0**	**550.0**	**520.0**	**564.0**	**607.8**
Peak	13.95	16.05	14.60	13.75	15.75	14.33
Average	10.02	12.39	10.99	9.75	12.03	10.96

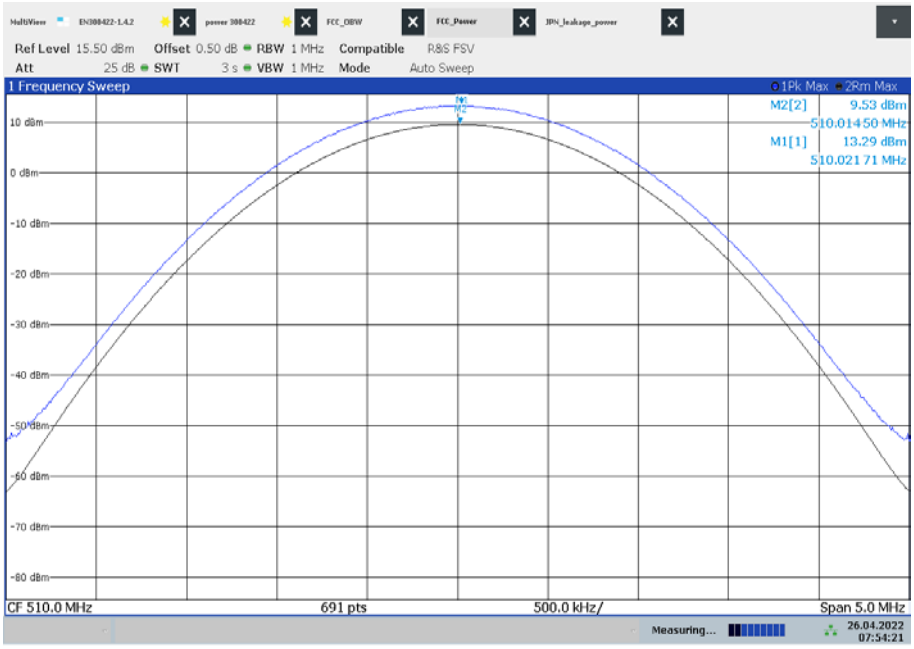
Plots output power conducted, normal mode:

Plot 1: 470.200 MHz



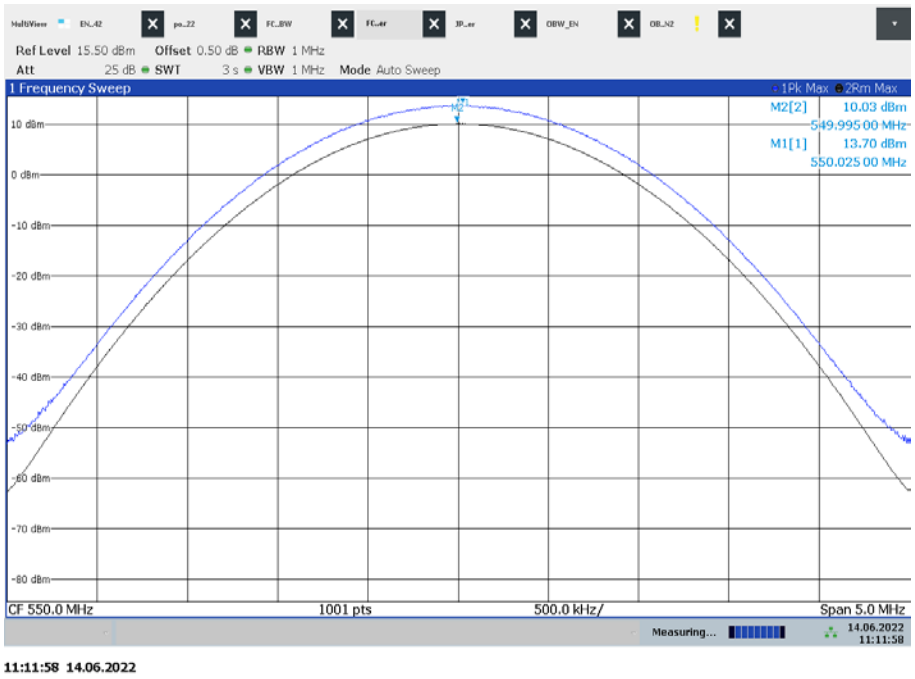
07:49:52 26.04.2022

Plot 2: 510.000 MHz



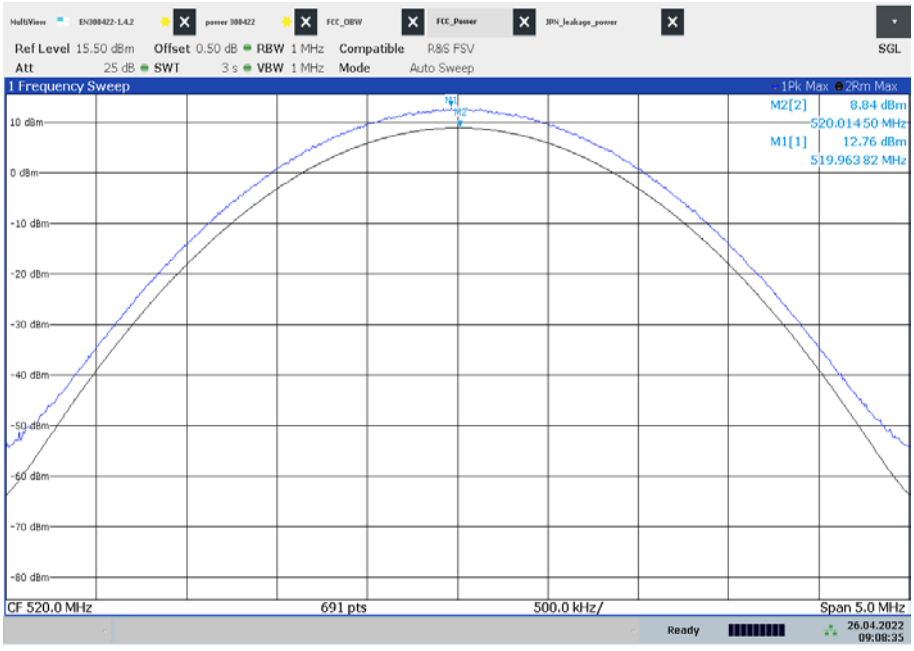
07:54:22 26.04.2022

Plot 3: 550.0 MHz



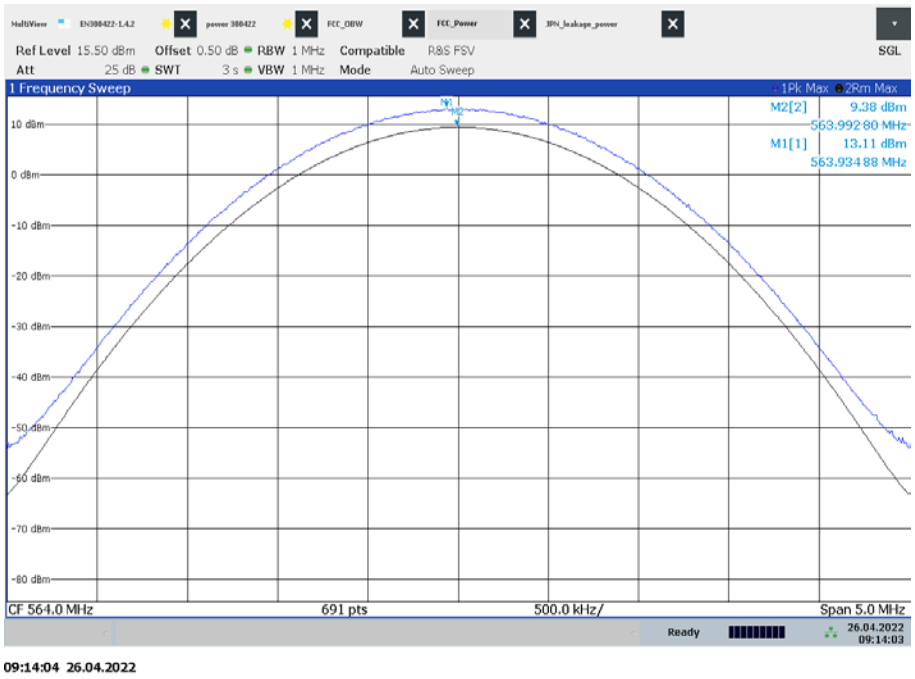
11:11:58 14.06.2022

Plot 4: 520.000 MHz

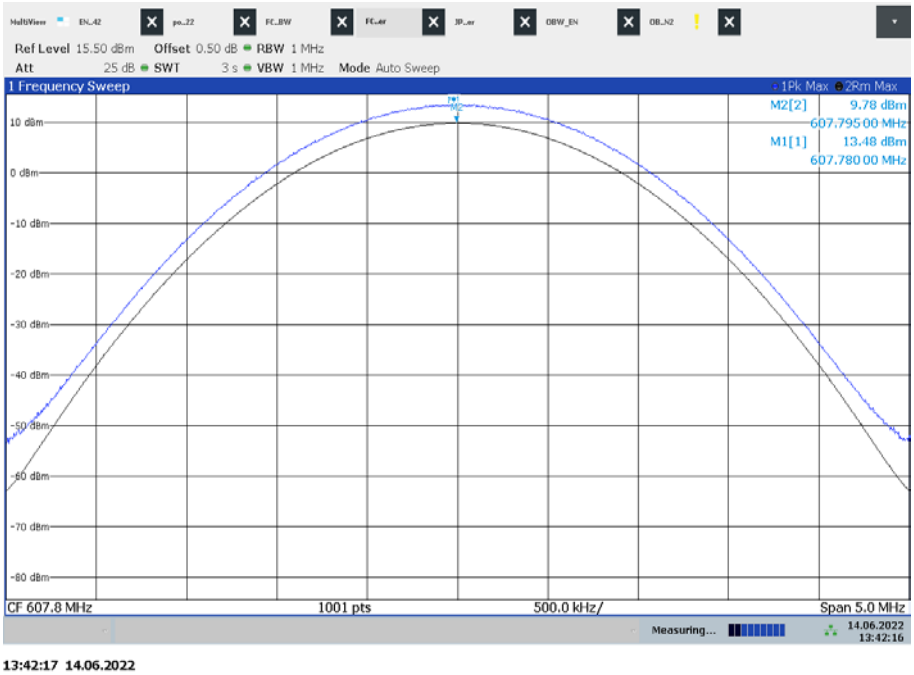


09:08:35 26.04.2022

Plot 5: 564.000 MHz

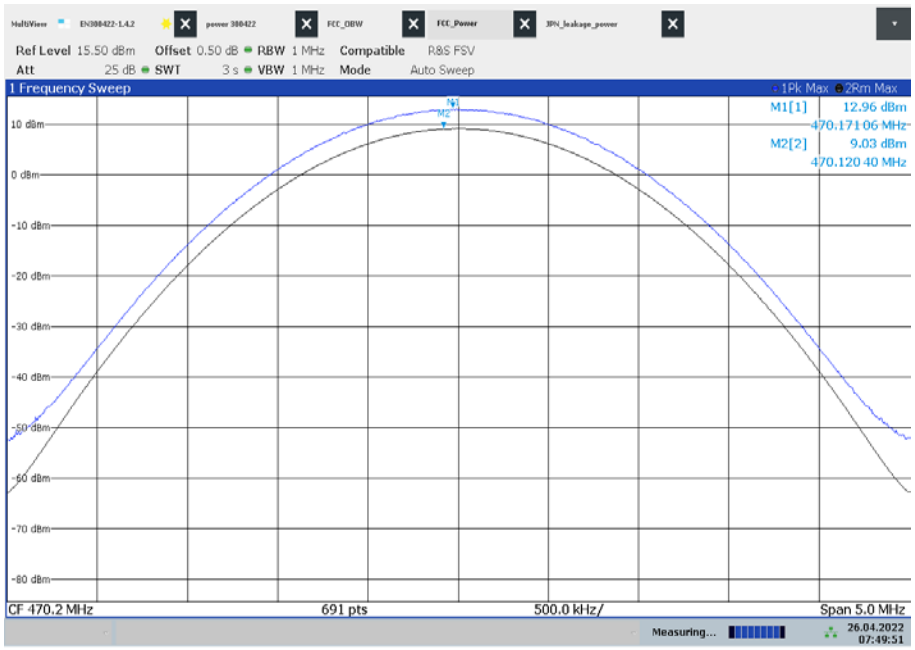


Plot 6: 607.8 MHz



Plots output power conducted, LD mode:

Plot 1: 470.200 MHz



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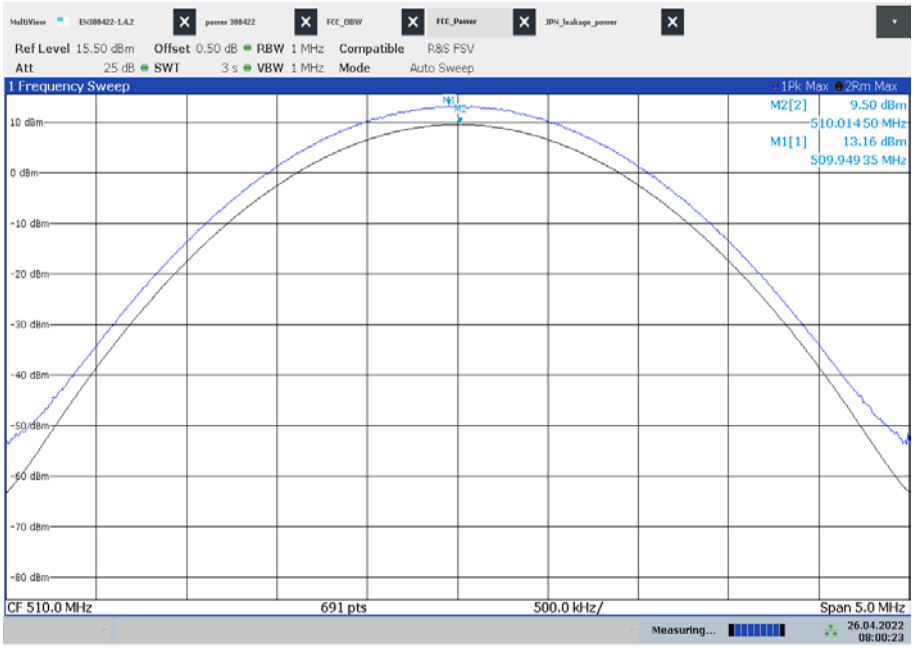
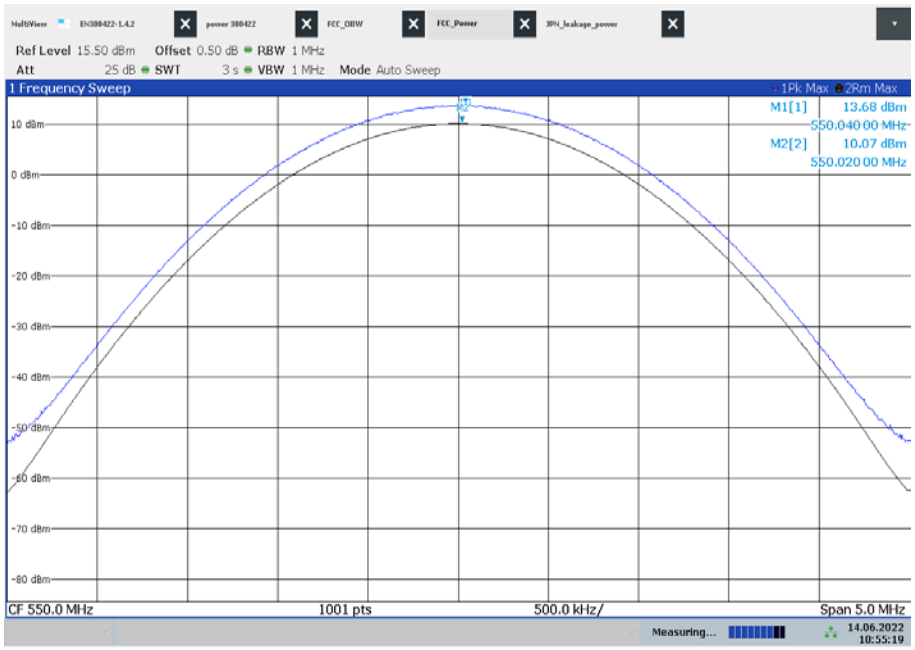
Plot 2: 510.000 MHz



08:00:24 26.04.2022

Plot 3: 550.0 MHz



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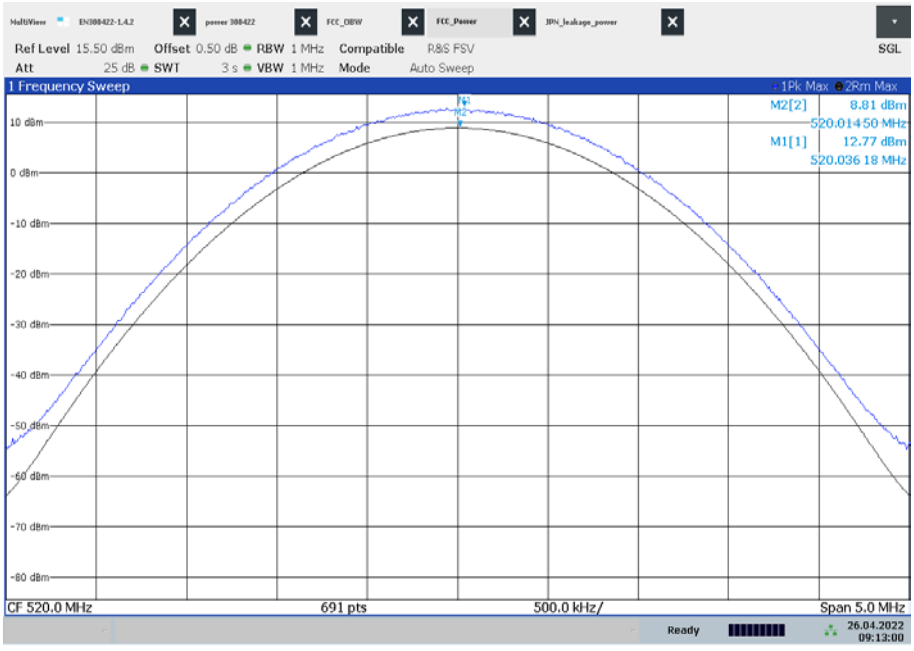
Plot 4: 520.000 MHz



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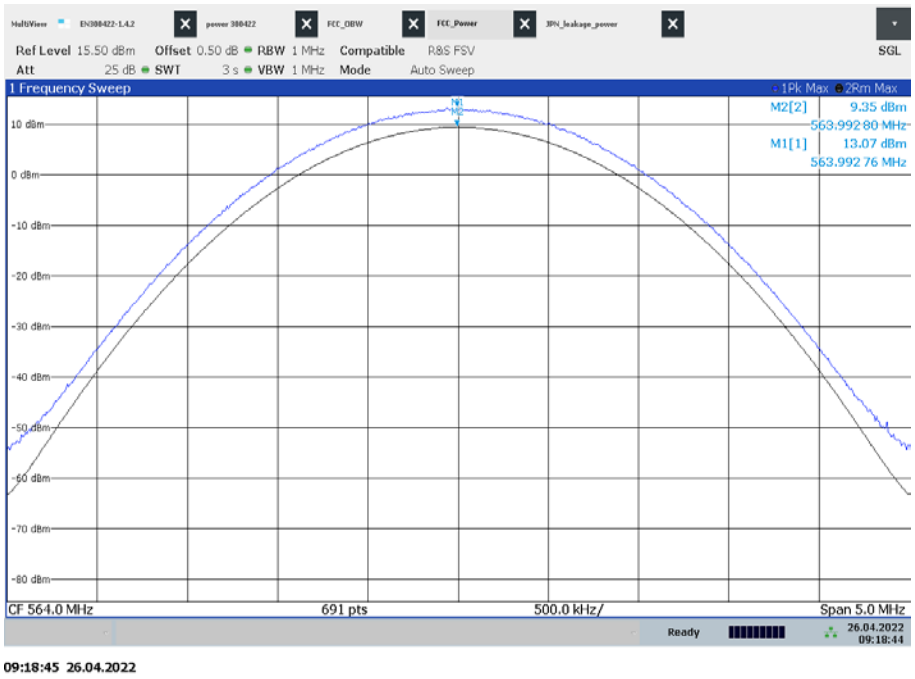
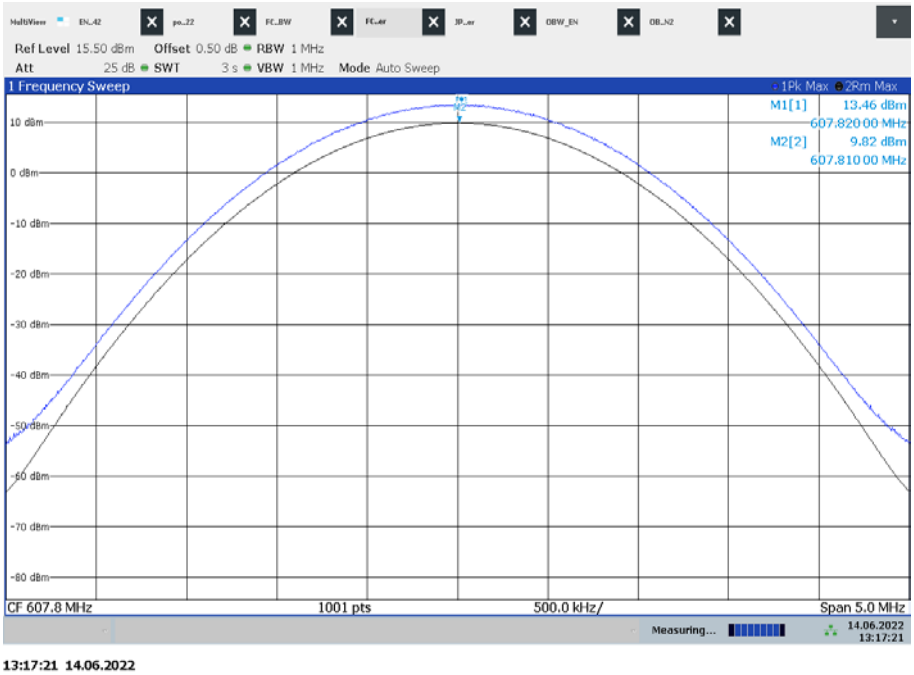
Plot 5: 564.000 MHz



Plot 6: 607.8 MHz



12.2 Occupied bandwidth

Measurement:

Measurement parameter	
Detector:	Peak
Sweep time:	Auto
Resolution bandwidth:	1 % to 5 % of the occupied bandwidth
Video bandwidth:	3 x resolution bandwidth
Span:	2 x emission bandwidth
Trace mode:	Max. hold
Analyzer function:	99% power occupied bandwidth function
EUT:	Modulated signal with max. frequency deviation
Test setup:	See sub clause 7.2 - A
Measurement uncertainty:	See sub clause 9

Limits:

FCC & IC
470 MHz to 608 MHz 200 kHz
Occupied bandwidth 99%. Other than single sideband or independent sideband transmitters - when modulated by a 2500 Hz tone at an input level 16 dB greater than that necessary to produce 50 percent modulation. The input level shall be established at the frequency of maximum response of the audio modulating circuit.

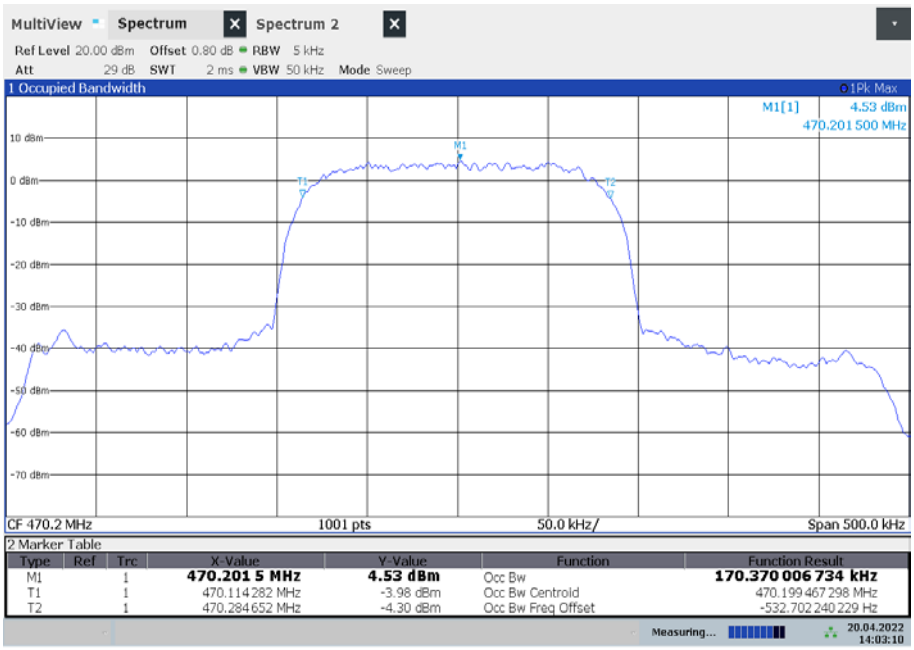
Result:

Normal mode	
Centre frequency (fc)	**OBW**
470.200 MHz	170.370 kHz
510.000 MHz	170.223 kHz
550.000 MHz	171.467 kHz
520.000 MHz	171.646 kHz
564.000 MHz	170.906 kHz
607.800 MHz	170.828 kHz

LD-mode	
Centre frequency (fc)	**OBW**
470.200 MHz	142.679 kHz
510.000 MHz	142.033 kHz
550.000 MHz	142.570 kHz
520.000 MHz	142.488 kHz
564.000 MHz	141.859 kHz
607.800 MHz	142.615 kHz

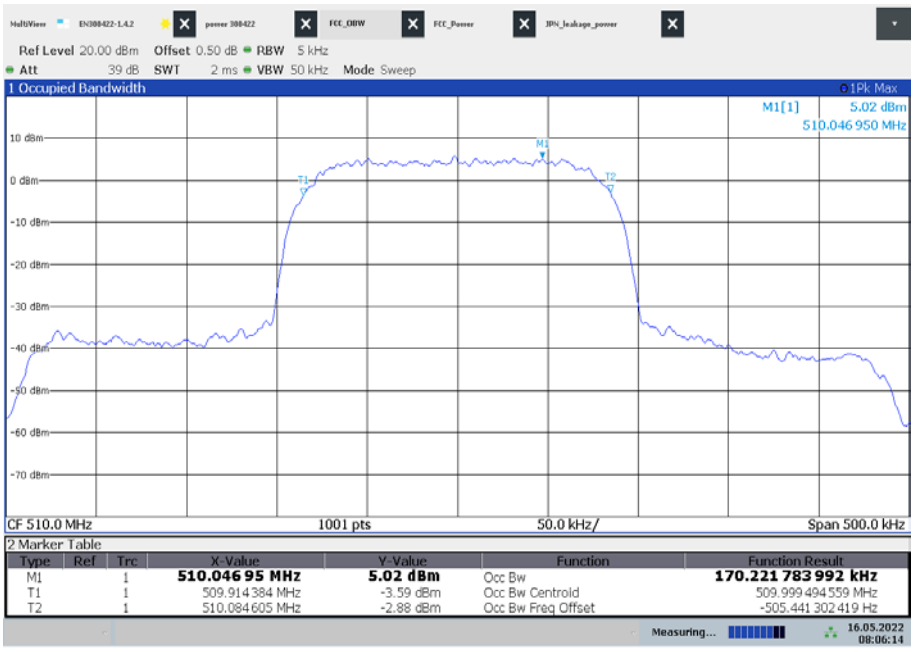
Plots normal mode:

Plot 1: 470.200 MHz, OBW



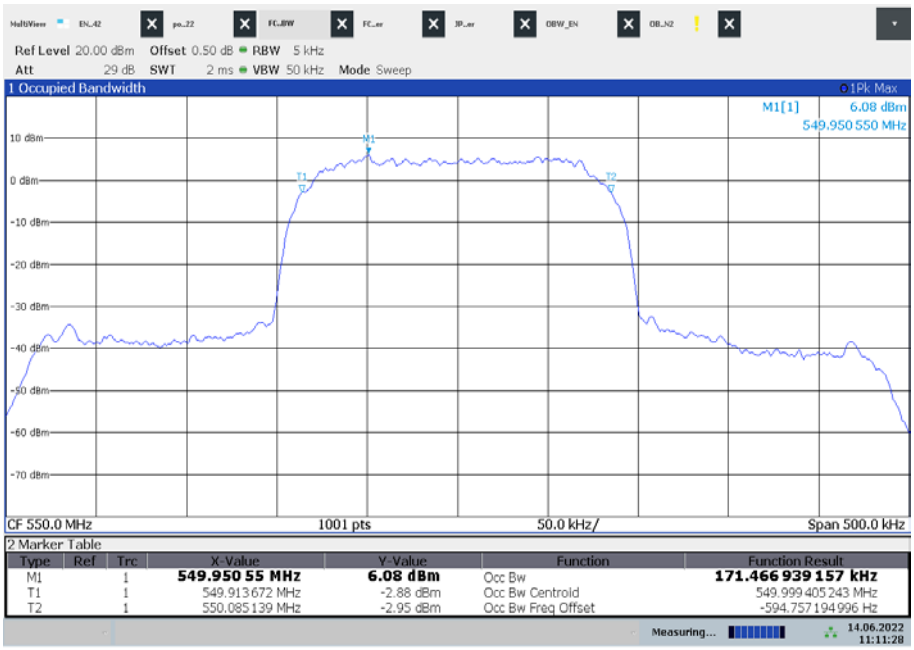
14:03:10 20.04.2022

Plot 2: 510.000 MHz, OBW



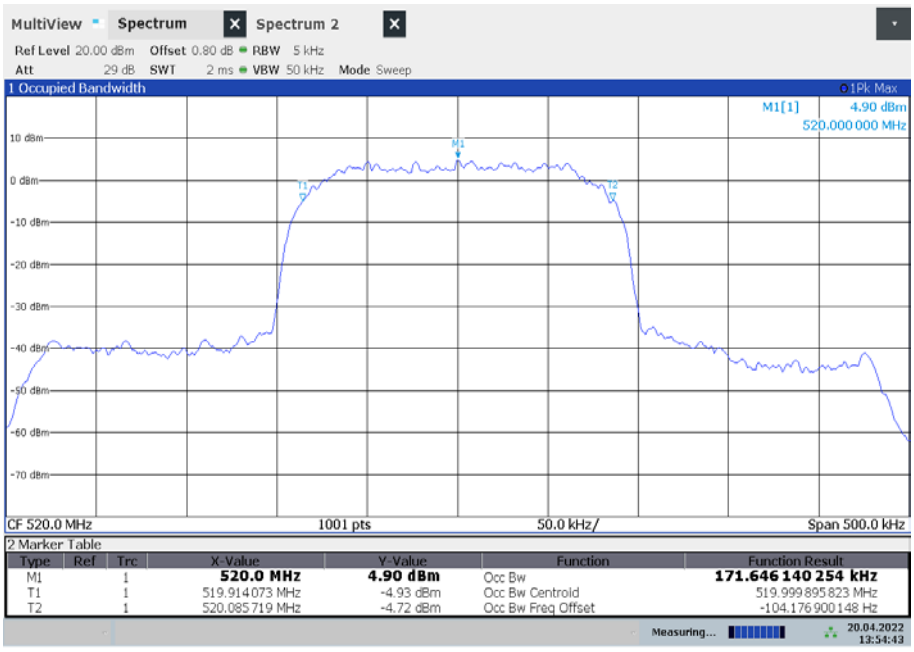
08:06:15 16.05.2022

Plot 3: 550.000 MHz, OBW



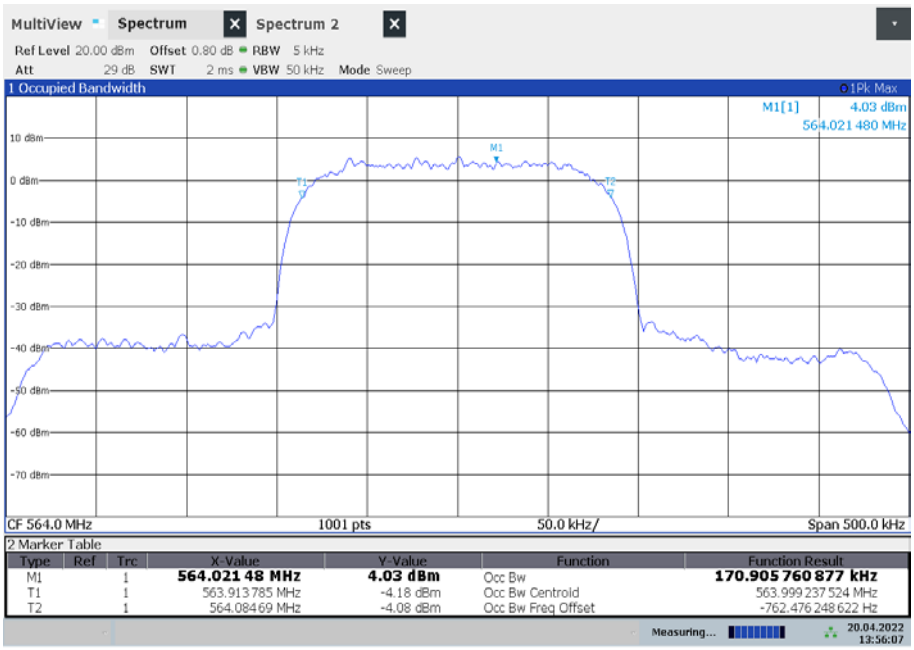
11:11:29 14.06.2022

Plot 4: 520.000 MHz, OBW



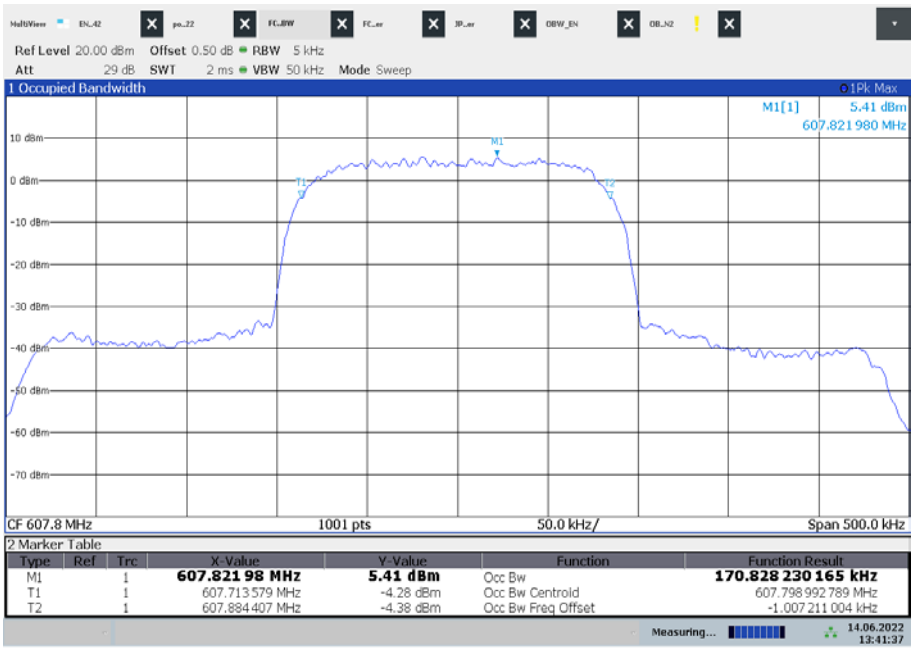
13:54:44 20.04.2022

Plot 5: 564.000 MHz, OBW



13:56:08 20.04.2022

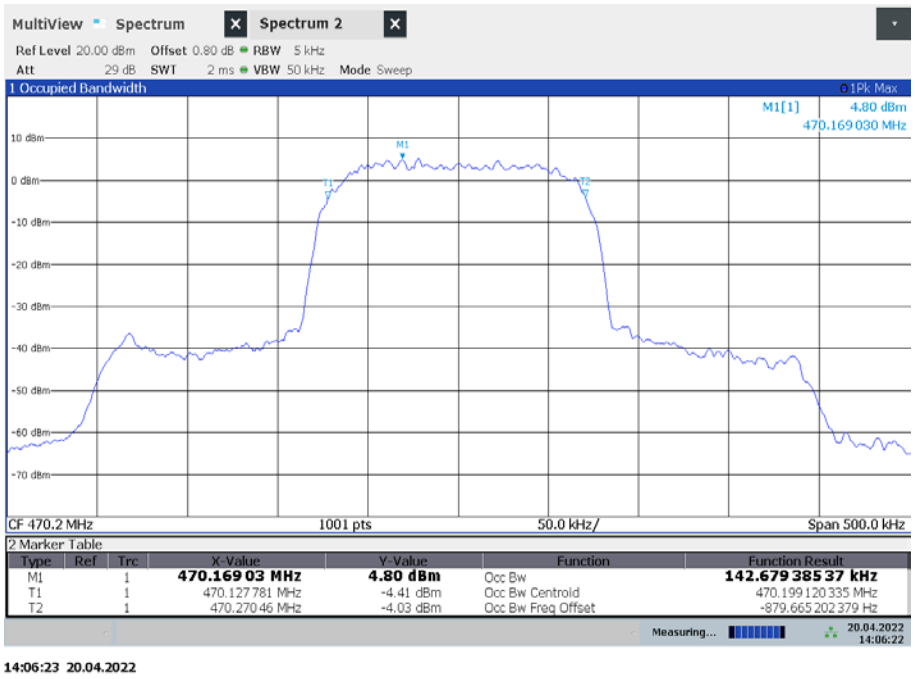
Plot 6: 607.800 MHz, OBW



13:41:37 14.06.2022

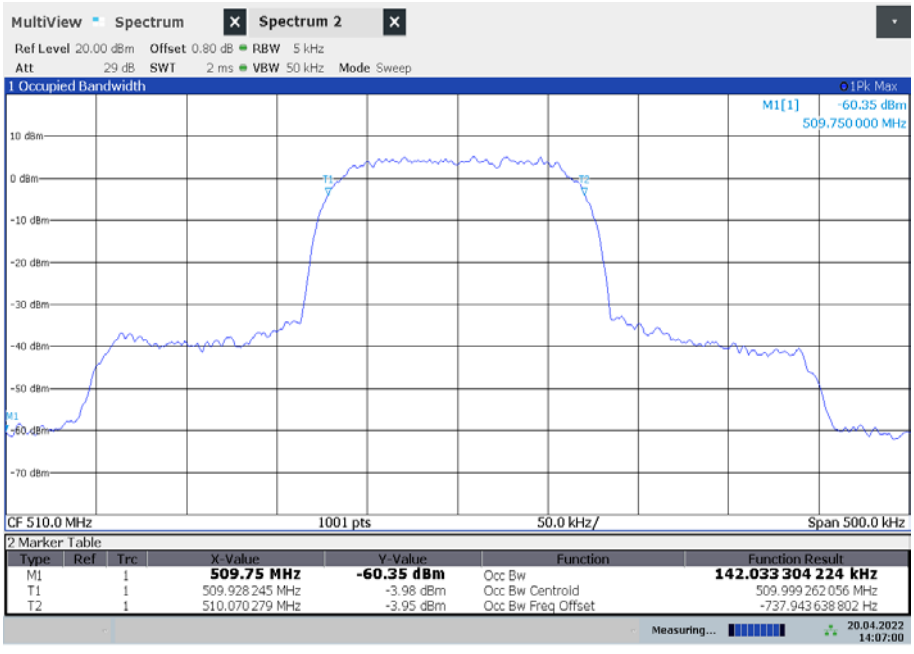
Plots LD mode:

Plot 1: 470.200 MHz, OBW



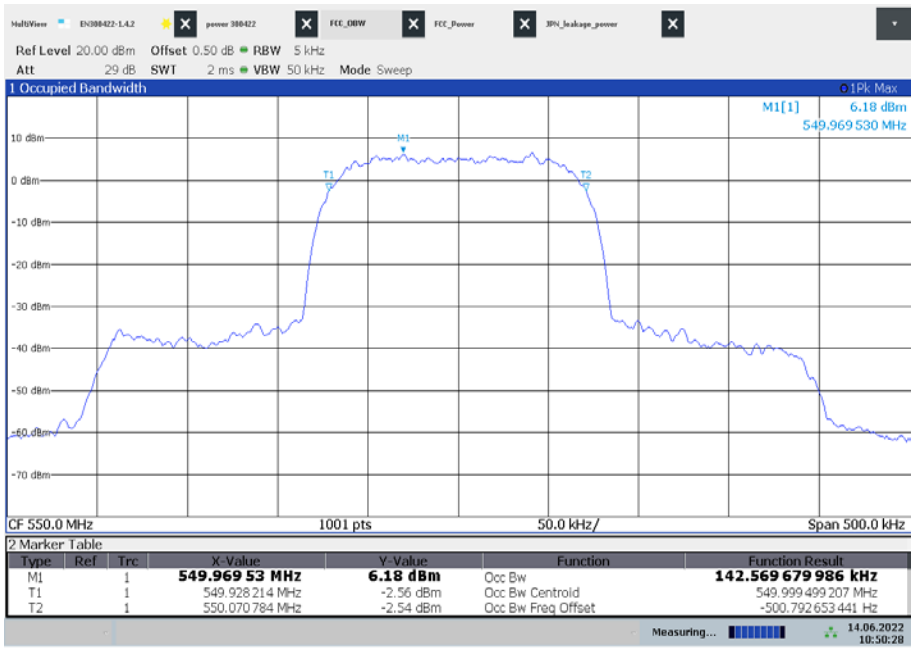
14:06:23 20.04.2022

Plot 2: 510.000 MHz, OBW



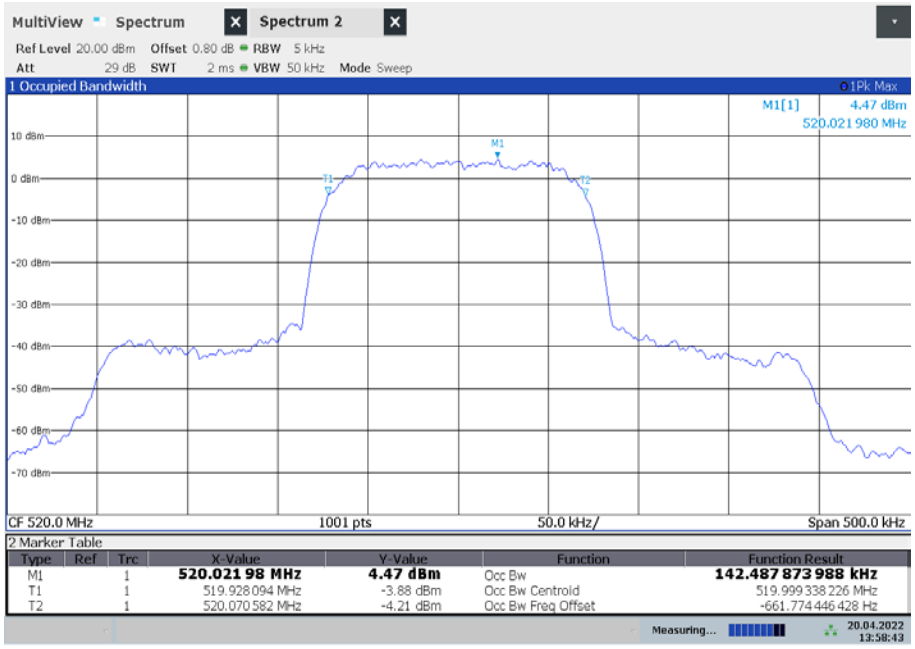
14:07:01 20.04.2022

Plot 3: 550.000 MHz, OBW



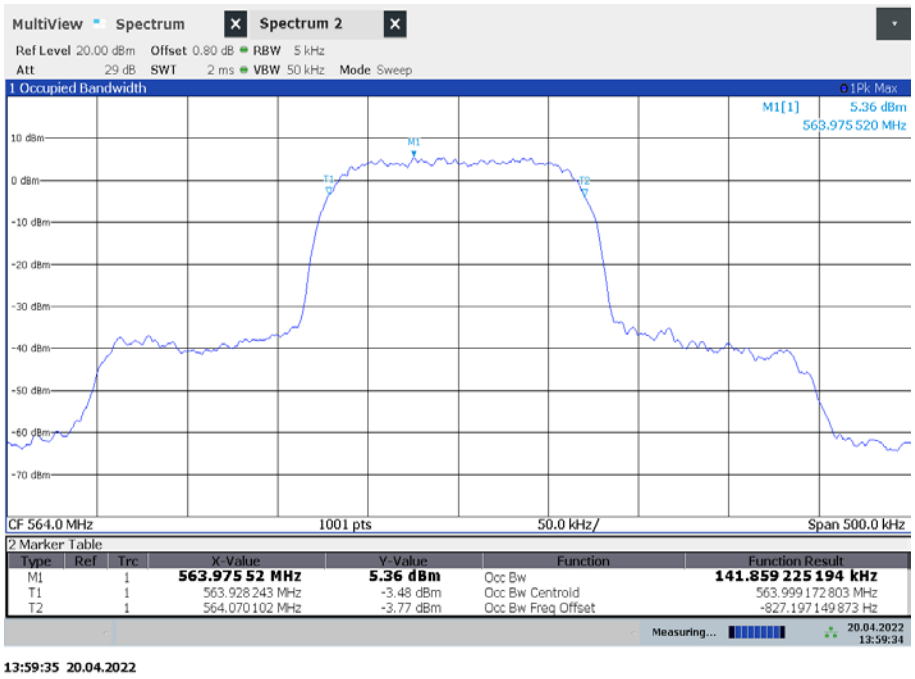
10:50:29 14.06.2022

Plot 4: 520.000 MHz, OBW



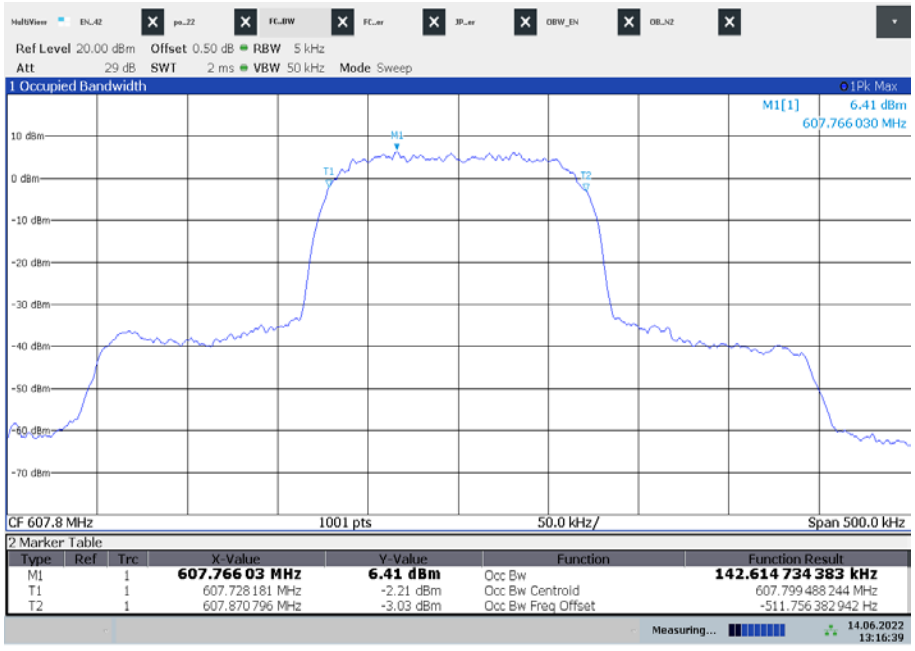
13:58:44 20.04.2022

Plot 5: 564.000 MHz, OBW



13:59:35 20.04.2022

Plot 6: 607.800 MHz, OBW



13:16:40 14.06.2022

12.3 Transmitter frequency stability

Measurement:

Measurement parameter	
Detector:	Peak
Sweep time:	Auto
Resolution bandwidth:	1 Hz / 10 Hz / 100 Hz
Video bandwidth:	3 x resolution bandwidth
Span:	wide enough to follow the frequency drift
Trace mode:	clear/write/view
EUT:	CW signal or MC with measurement method description
Test setup:	See sub clause 7.2 - B
Measurement uncertainty:	See sub clause 9

Limits:

FCC & IC
470 MHz to 608 MHz ± 50 ppm

Results: 470.200 MHz

Temperature / Voltage	Frequency (MHz)	Deviation (kHz / ppm)
-30 °C / V_{nom}	470.19935	-0.650 / 1.382
-20 °C / V_{nom}	470.19960	-0.400 / 0.851
-10 °C / V_{nom}	470.19990	-0.100 / 0.213
0 °C / V_{nom}	470.20010	0.100 / 0.213
+10 °C / V_{nom}	470.20015	0.150 / 0.319
+20 °C / V_{nom}	470.20020	0.200 / 0.425
+30 °C / V_{nom}	470.20015	0.150 / 0.319
+40 °C / V_{nom}	470.20015	0.150 / 0.319
+50 °C / V_{nom}	470.20010	0.100 / 0.213
+20 °C / V_{nom} - 15%	470.20020	0.200 / 0.425
+20 °C / V_{nom}	470.20020	0.200 / 0.425
+20 °C / V_{nom} + 15%	470.20020	0.200 / 0.425

Results: 510.000 MHz

Temperature / Voltage	Frequency (MHz)	Deviation (kHz / ppm)
-30 °C / V_{nom}	509.99935	-0.650 / 1.275
-20 °C / V_{nom}	509.99960	-0.400 / 0.784
-10 °C / V_{nom}	509.99995	-0.050 / 0.098
0 °C / V_{nom}	510.00015	0.150 / 0.294
+10 °C / V_{nom}	510.00015	0.150 / 0.294
+20 °C / V_{nom}	510.00020	0.200 / 0.392
+30 °C / V_{nom}	510.00015	0.150 / 0.294
+40 °C / V_{nom}	510.00015	0.150 / 0.294
+50 °C / V_{nom}	510.00015	0.150 / 0.294
+20 °C / V_{nom} - 15%	510.00020	0.200 / 0.392
+20 °C / V_{nom}	510.00020	0.200 / 0.392
+20 °C / V_{nom} + 15%	510.00020	0.200 / 0.392

Results: 550.000 MHz

Temperature / Voltage	Frequency (MHz)	Deviation (kHz / ppm)
-30 °C / V_{nom}	549.99935	-0.650 / 1.182
-20 °C / V_{nom}	549.99960	-0.400 / 0.728
-10 °C / V_{nom}	549.99995	-0.050 / 0.091
0 °C / V_{nom}	550.00010	0.100 / 0.182
+10 °C / V_{nom}	550.00020	0.200 / 0.364
+20 °C / V_{nom}	550.00020	0.200 / 0.364
+30 °C / V_{nom}	550.00015	0.150 / 0.273
+40 °C / V_{nom}	550.00015	0.150 / 0.273
+50 °C / V_{nom}	550.00015	0.150 / 0.273
+20 °C / V_{nom} - 15%	550.00020	0.200 / 0.364
+20 °C / V_{nom}	550.00020	0.200 / 0.364
+20 °C / V_{nom} + 15%	550.00020	0.200 / 0.364

Results: 520.000 MHz

Temperature / Voltage	Frequency (MHz)	Deviation (kHz / ppm)
-30 °C / V_{nom}	519.99940	-0.600 / 1.154
-20 °C / V_{nom}	519.99950	-0.500 / 0.962
-10 °C / V_{nom}	519.99980	-0.200 / 0.385
0 °C / V_{nom}	519.99970	-0.300 / 0.577
+10 °C / V_{nom}	519.99980	-0.200 / 0.385
+20 °C / V_{nom}	519.99850	-1.500 / 2.885
+30 °C / V_{nom}	519.99850	-1.500 / 2.885
+40 °C / V_{nom}	519.99950	-0.500 / 0.962
+50 °C / V_{nom}	520.00000	0.000 / 0.000
+20 °C / V_{nom} - 15%	519.99985	-0.150 / 0.288
+20 °C / V_{nom}	519.99850	-0.150 / 0.288
+20 °C / V_{nom} + 15%	519.99985	-0.150 / 0.288

Results: 564.000 MHz

Temperature / Voltage	Frequency (MHz)	Deviation (kHz / ppm)
-30 °C / V_{nom}	563.99935	-0.650 / 1.152
-20 °C / V_{nom}	563.99950	-0.500 / 0.887
-10 °C / V_{nom}	563.99970	-0.300 / 0.532
0 °C / V_{nom}	563.99975	-0.250 / 0.443
+10 °C / V_{nom}	563.99980	-0.200 / 0.355
+20 °C / V_{nom}	563.99985	-0.150 / 0.266
+30 °C / V_{nom}	563.99985	-0.150 / 0.266
+40 °C / V_{nom}	563.99995	-0.050 / 0.089
+50 °C / V_{nom}	564.00000	0.000 / 0.000
+20 °C / V_{nom} - 15%	563.99985	-0.150 / 0.266
+20 °C / V_{nom}	563.99985	-0.150 / 0.266
+20 °C / V_{nom} + 15%	563.99985	-0.150 / 0.266

Results: 607.8 MHz

Temperature / Voltage	Frequency (MHz)	Deviation (kHz / ppm)
-30 °C / V_{nom}	607.79930	-0.700 / 1.152
-20 °C / V_{nom}	607.79935	-0.650 / 1.069
-10 °C / V_{nom}	607.79965	-0.350 / 0.576
0 °C / V_{nom}	607.79970	-0.300 / 0.494
+10 °C / V_{nom}	607.79975	-0.250 / 0.411
+20 °C / V_{nom}	607.79975	-0.250 / 0.411
+30 °C / V_{nom}	607.79985	-0.150 / 0.247
+40 °C / V_{nom}	607.79990	-0.100 / 0.165
+50 °C / V_{nom}	607.80000	0.000 / 0.000
+20 °C / V_{nom} - 15%	607.79975	-0.250 / 0.411
+20 °C / V_{nom}	607.79975	-0.250 / 0.411
+20 °C / V_{nom} + 15%	607.79975	-0.250 / 0.411

12.4 Transmitter unwanted emissions (radiated)

Measurement:

Measurement parameter	
Detector:	Peak (prescan) / RMS
Sweep time:	Auto
Resolution bandwidth:	25 MHz to 30 MHz 9 kHz to 10 kHz 30 MHz to 1 000 MHz 100 kHz > 1 000 MHz 1 MHz
Video bandwidth:	3 * RBW
Span:	100 MHz steps!
Trace-Mode:	Max. hold
EUT:	MC with max frequency deviation
Used equipment:	See chapter 7.1- A / B
Measurement uncertainty:	See chapter 8

Limits:

Max. spurious level FCC & IC (according to ETSI EN 300 422-1 v1.4.2 (2011-08))			
State	47 MHz to 74 MHz 87.5 MHz to 118 MHz 174 MHz to 230 MHz 470 MHz to 862 MHz	Other frequencies ≤ 1000 MHz	All frequencies > 1000 MHz
Operating	4.0 nW	250 nW	1.00 µW
Standby	2.0 nW	2.0 nW	20.0 nW

FCC & IC	
The mean power of emissions shall be attenuated below the mean output power of the transmitter in accordance with the following schedule:	
On any frequency removed from the operating frequency by more than 50 percent up to and including 100 percent of the authorized bandwidth: at least	25 dB
On any frequency removed from the operating frequency by more than 100 percent up to and including 250 percent of the authorized bandwidth	35 dB
On any frequency removed from the operating frequency by more than 250 percent of the authorized bandwidth: at least	43 + 10log10 (mean output power in watts) dB

Results:

normal mode:

carrier frequency (MHz)	unwanted emission frequency (MHz)	Limit	level (dB) / (dBm) or remark
470.2	1410.4	-30 dBm	-65.4 dBm
510.0	all detected emissions are more than 10 dB below the limit.		
550.0	all detected emissions are more than 10 dB below the limit.		
520.0	1039.6	-30 dBm	-65.21 dBm
564.0	all detected emissions are more than 10 dB below the limit.		
607.8	all detected emissions are more than 10 dB below the limit.		

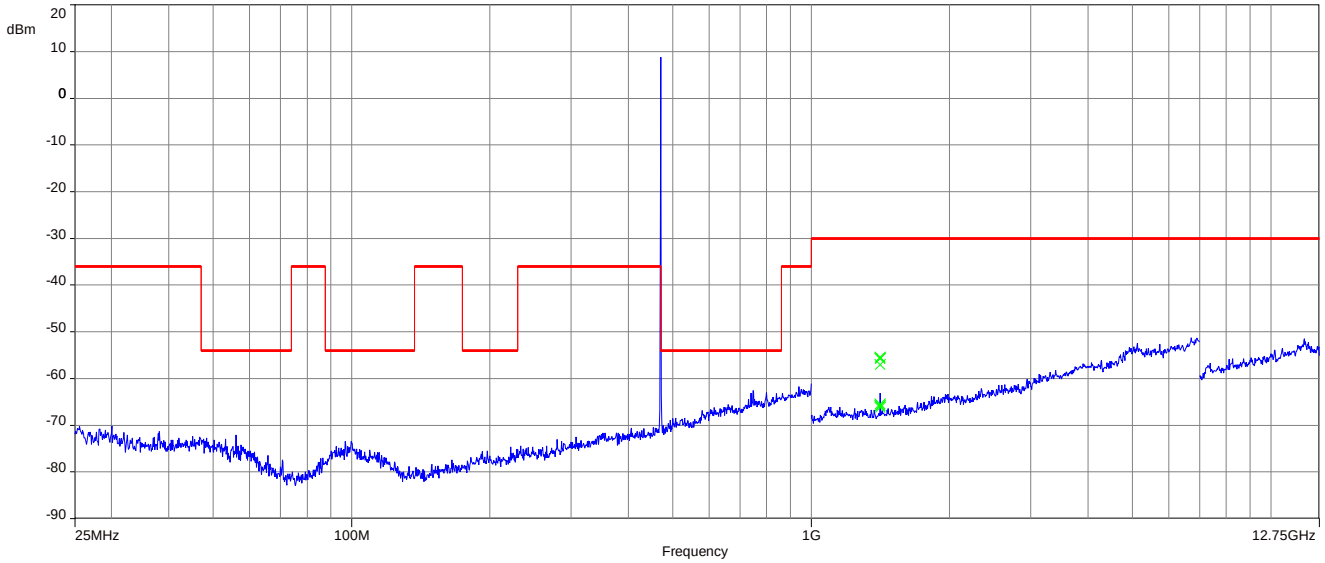
LD mode:

carrier frequency (MHz)	unwanted emission frequency (MHz)	Limit	level (dB) / (dBm) or remark
470.2	all detected emissions are more than 10 dB below the limit.		
510.0	all detected emissions are more than 10 dB below the limit.		
550.0	all detected emissions are more than 10 dB below the limit.		
520.0	all detected emissions are more than 10 dB below the limit.		
564.0	all detected emissions are more than 10 dB below the limit.		
607.8	all detected emissions are more than 10 dB below the limit.		

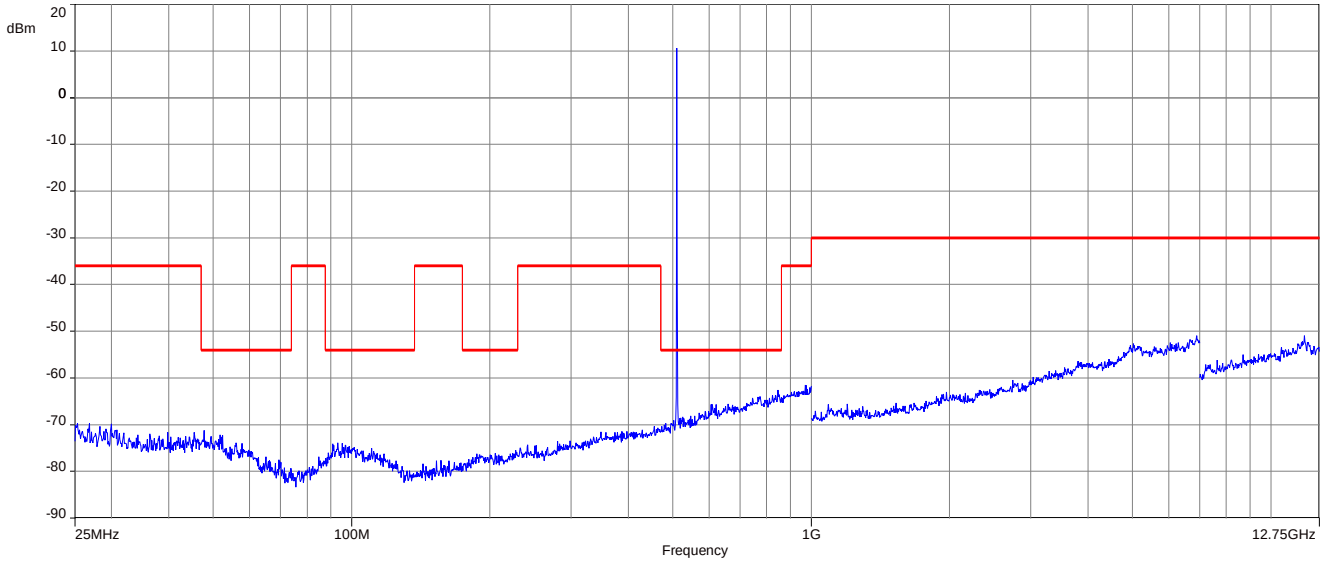
Plots: radiated

normal mode:

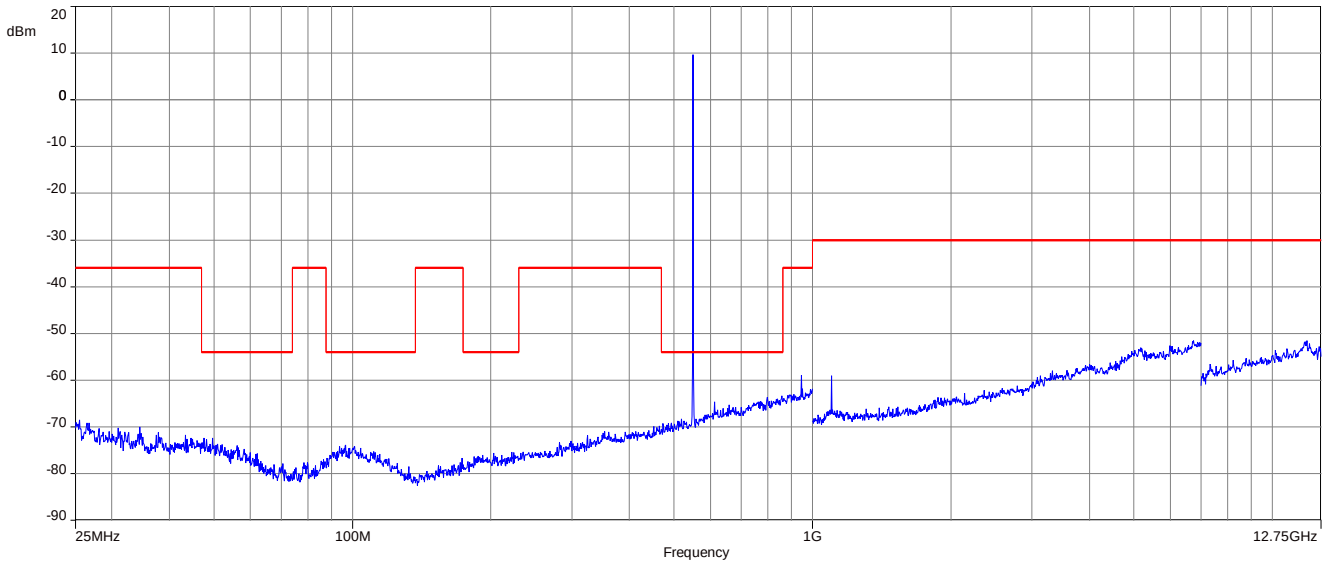
Plot 1: 470.200 MHz, 25 MHz – 12.75 GHz



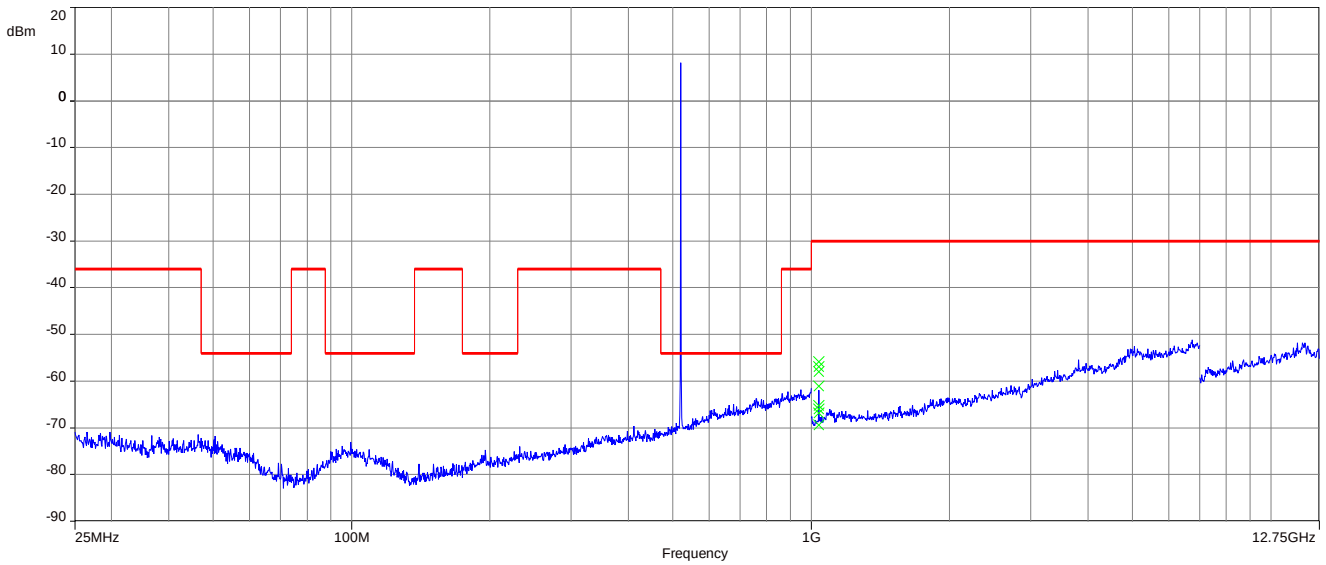
Plot 2: 510.000 MHz, 25 MHz – 12.75 GHz



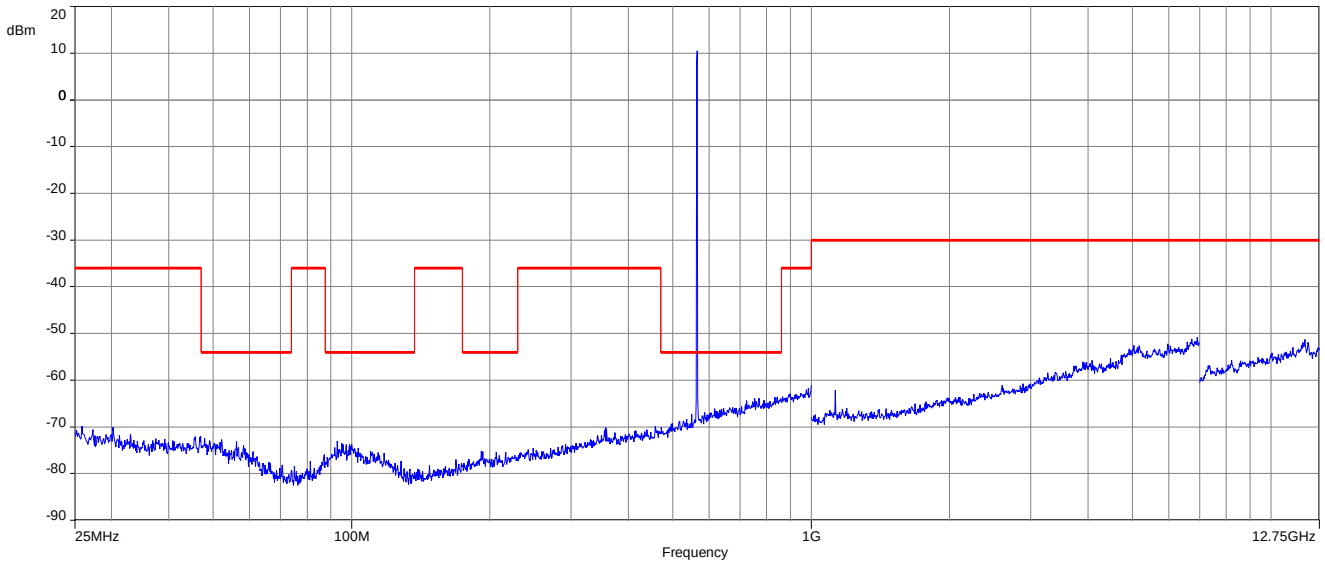
Plot 3: 550.000 MHz, 25 MHz – 12.75 GHz



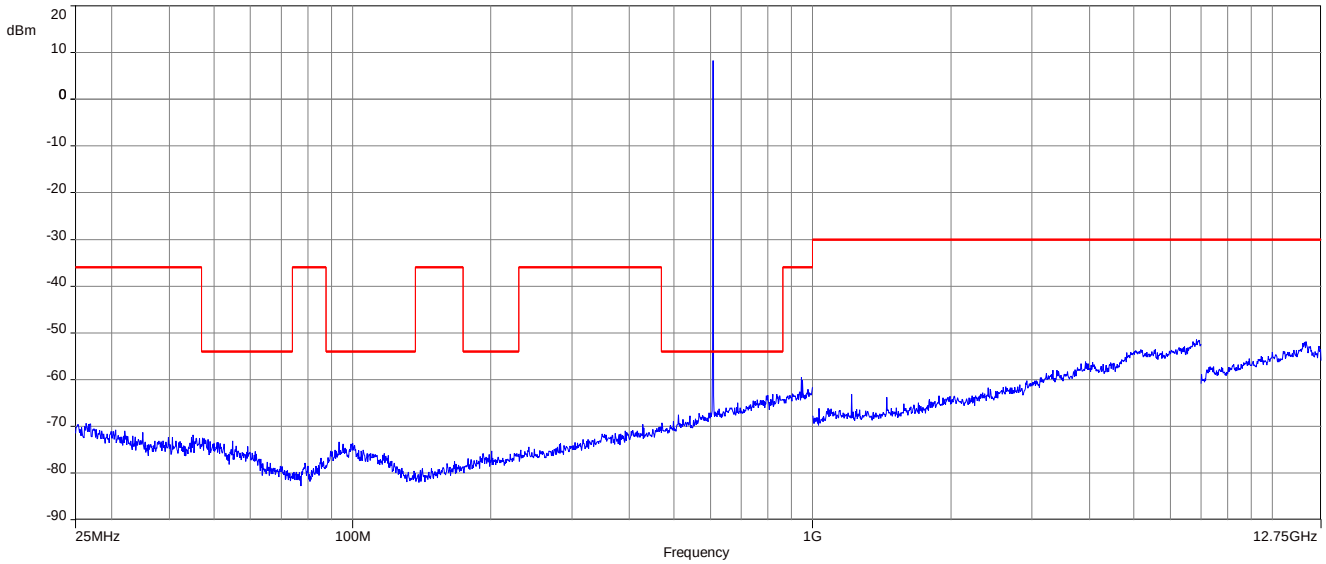
Plot 4: 520.000 MHz, 25 MHz – 12.75 GHz



Plot 5: 564.000 MHz, 25 MHz – 12.75 GHz

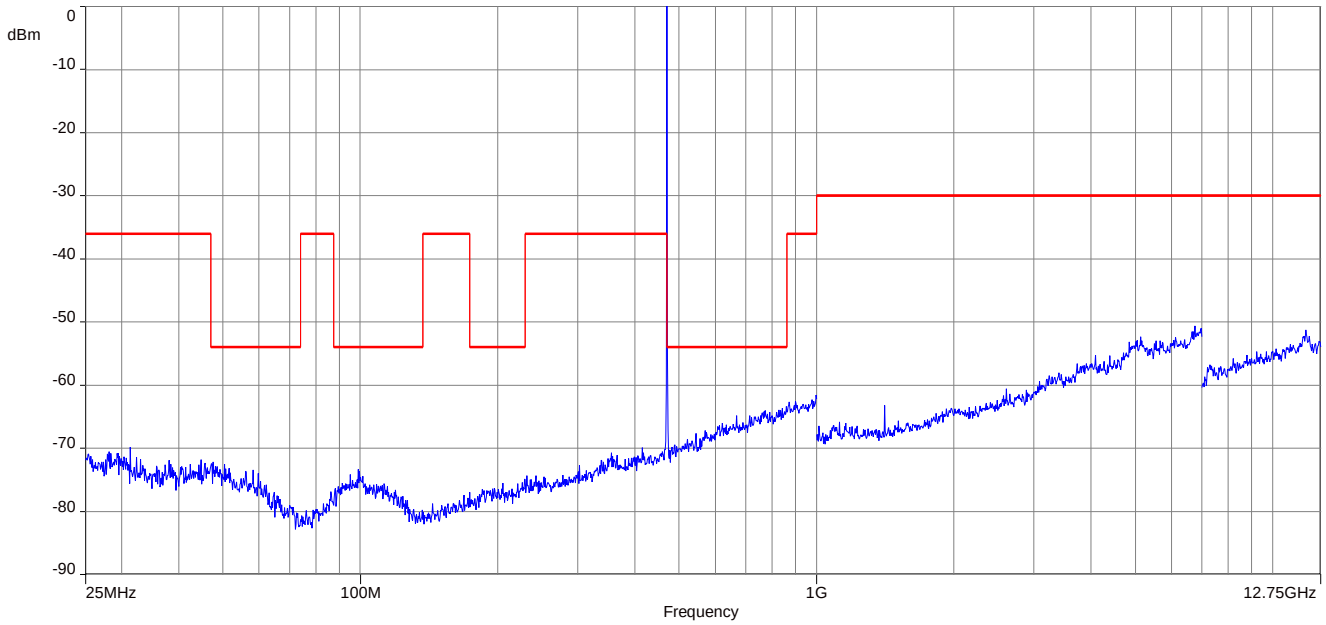


Plot 6: 607.800 MHz, 25 MHz – 12.75 GHz

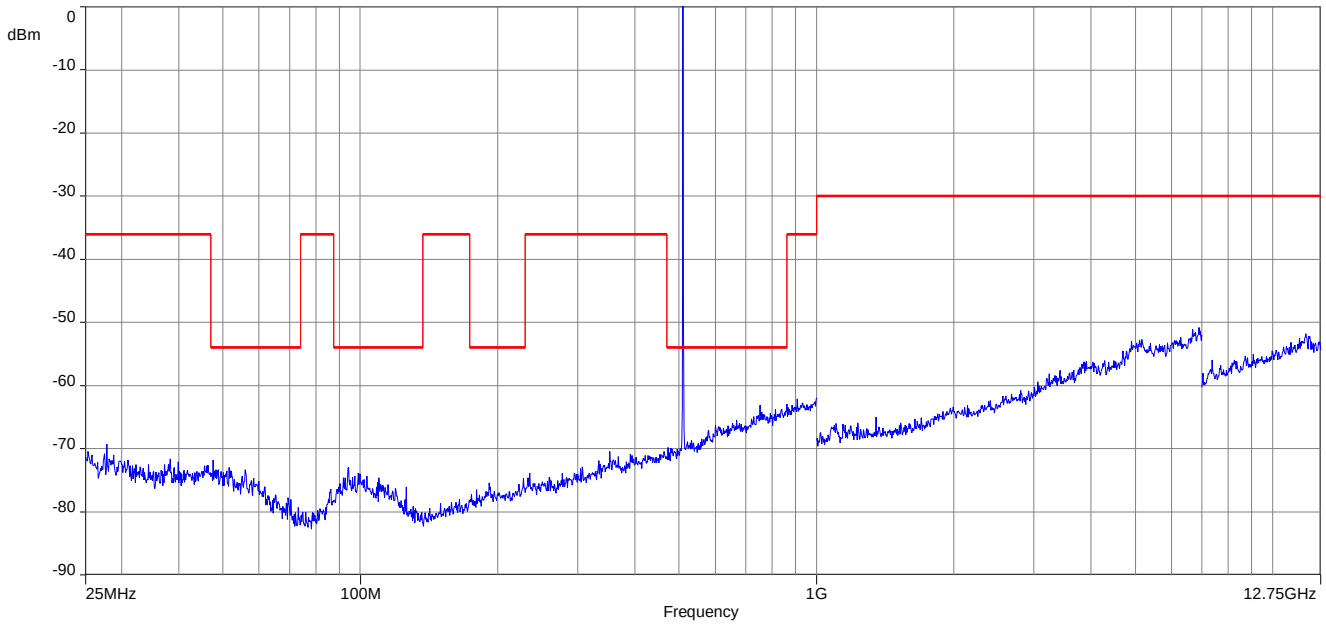


LD mode:

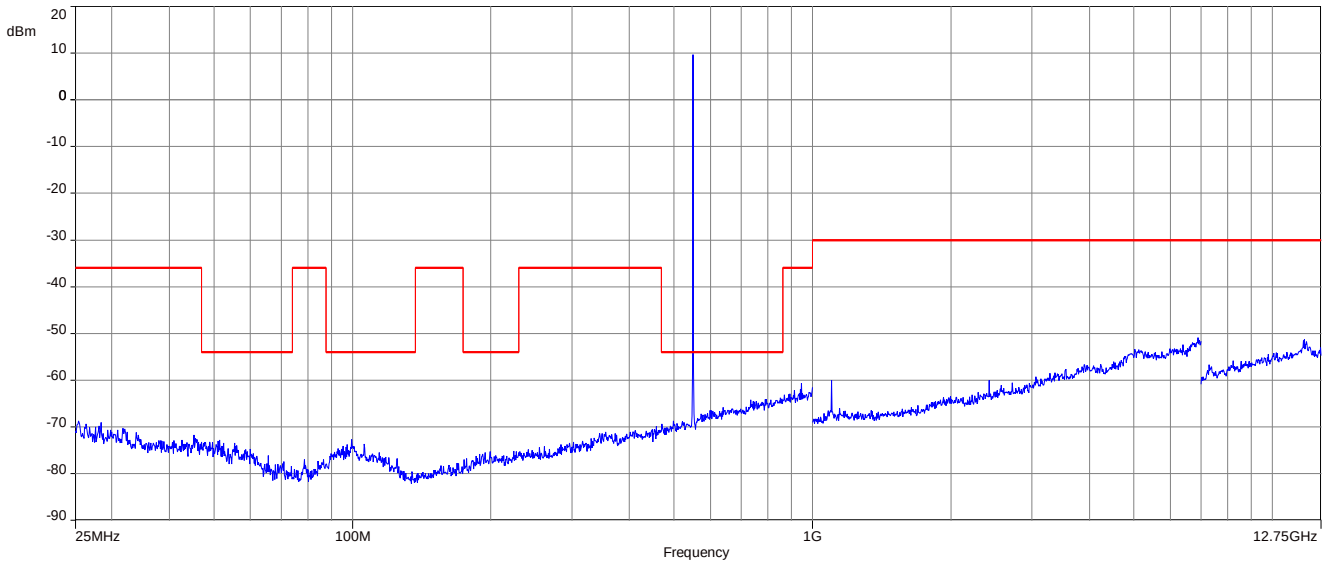
Plot 1: 470.200 MHz, 25 MHz – 12.75 GHz



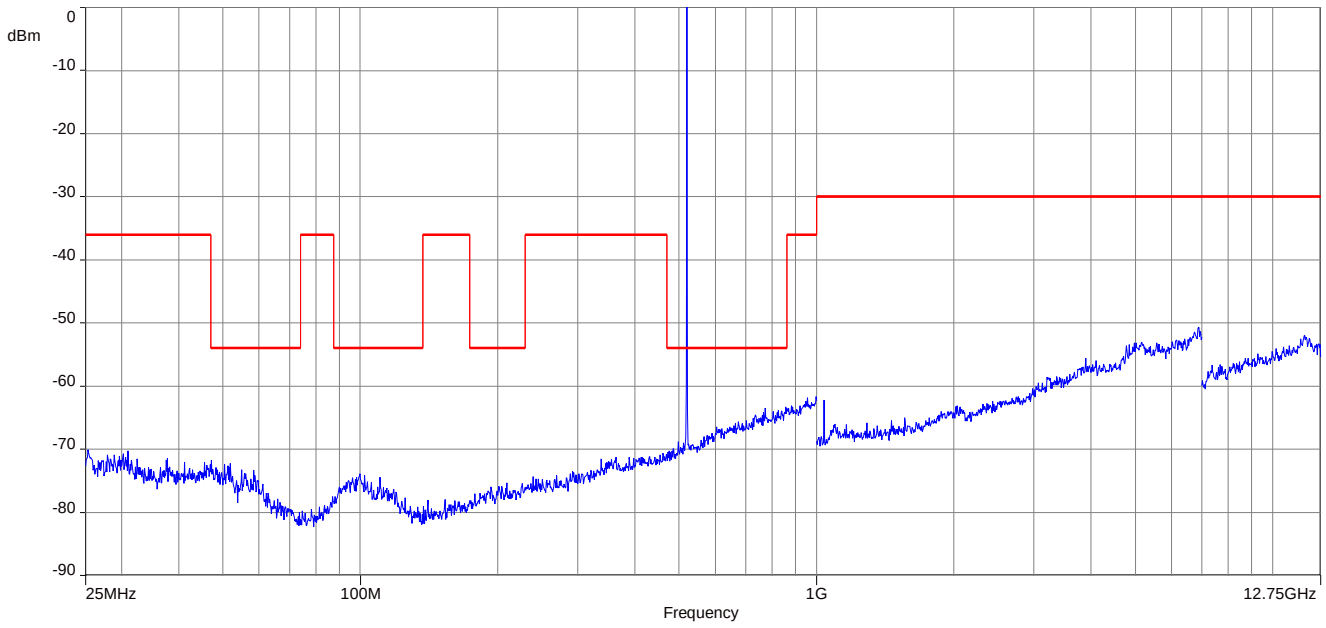
Plot 2: 510.000 MHz, 25 MHz – 12.75 GHz



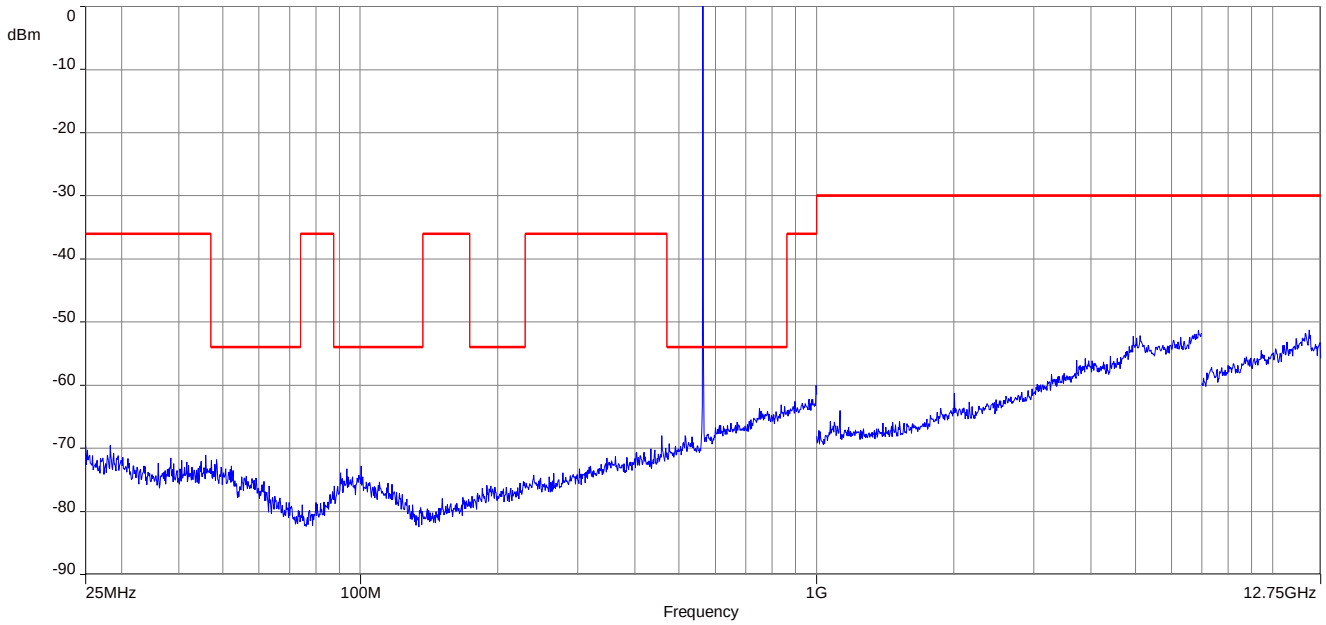
Plot 3: 550.000 MHz, 25 MHz – 12.75 GHz



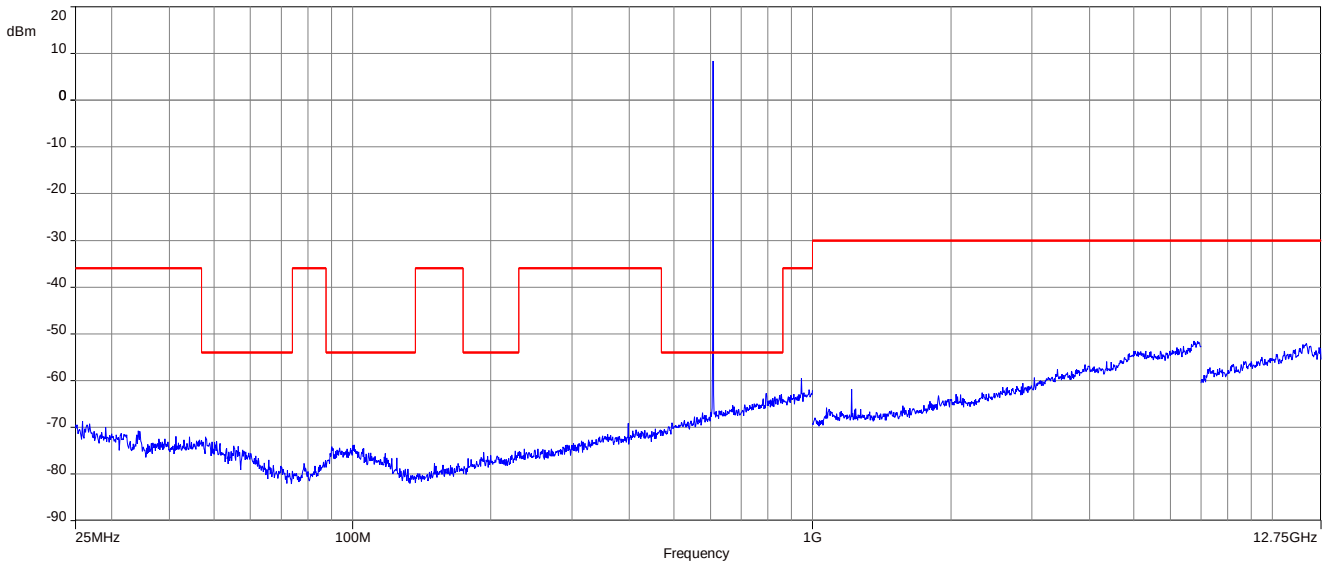
Plot 4: 520.000 MHz, 25 MHz – 12.75 GHz



Plot 5: 564.000 MHz, 25 MHz – 12.75 GHz



Plot 6: 607.800 MHz, 25 MHz – 12.75 GHz

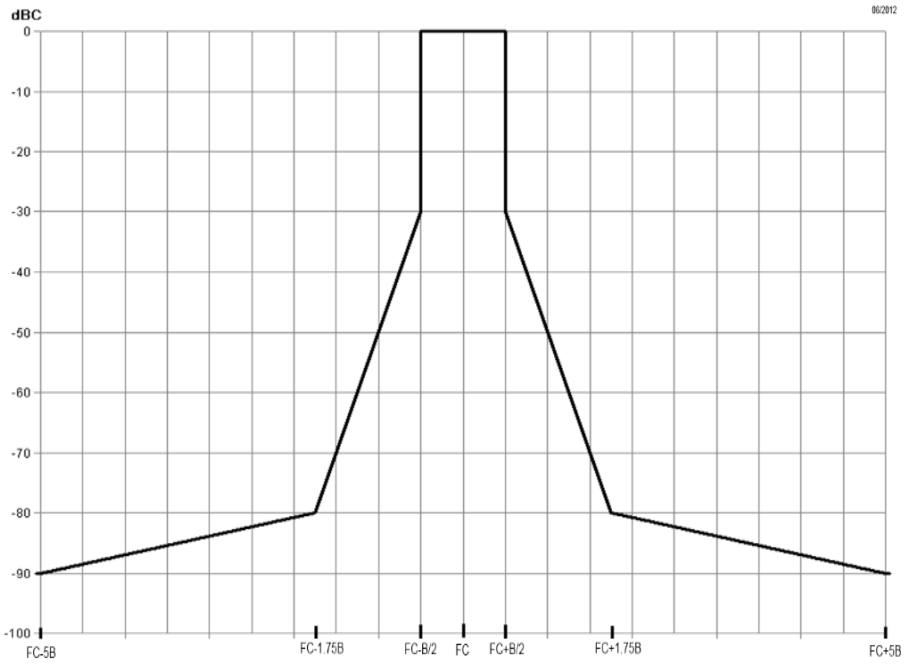


12.5 Necessary bandwidth (BN) for digital systems

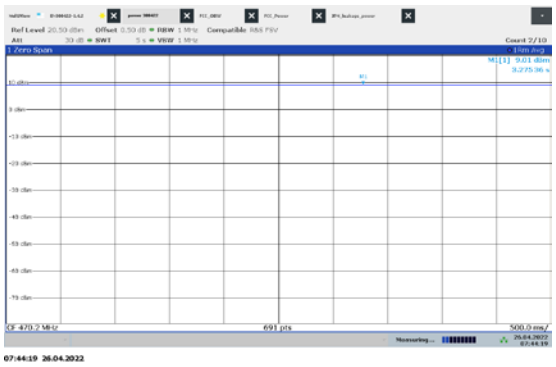
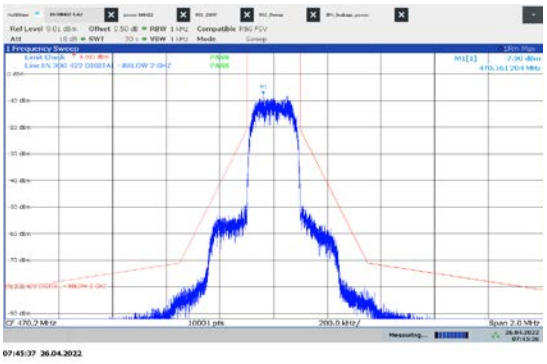
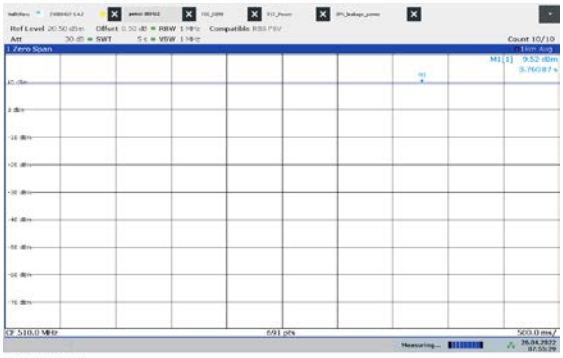
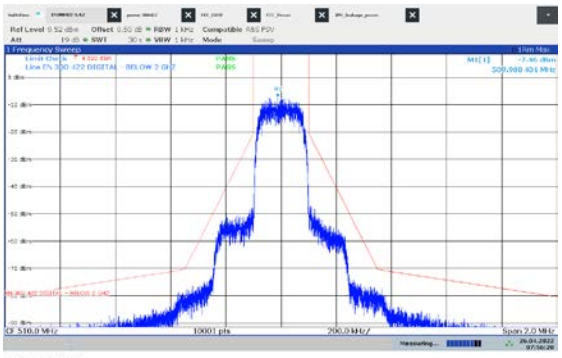
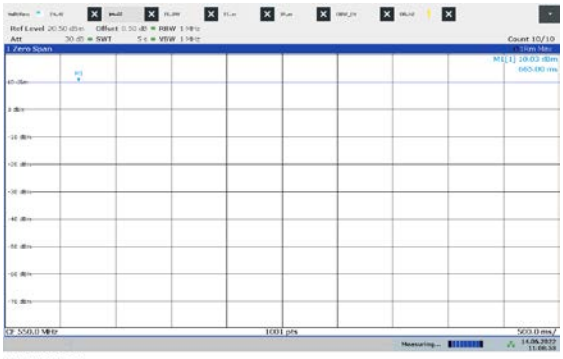
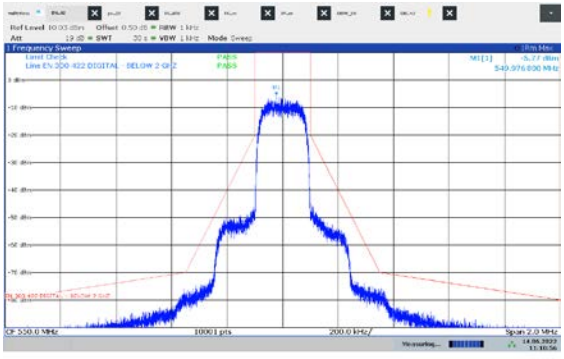
Measurement:

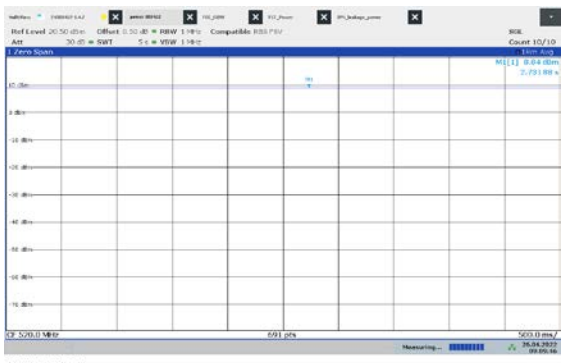
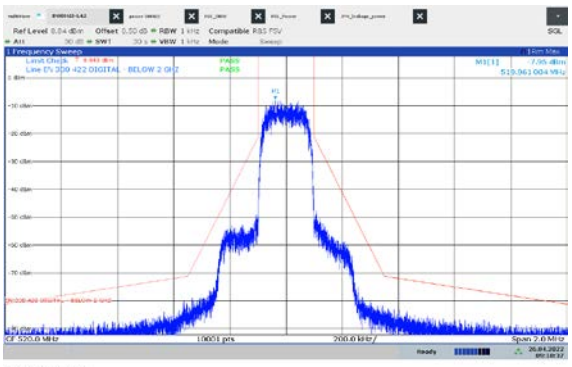
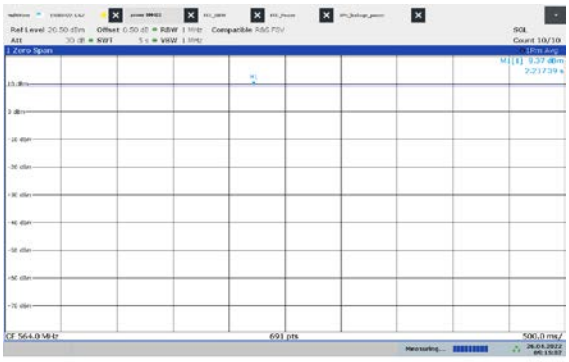
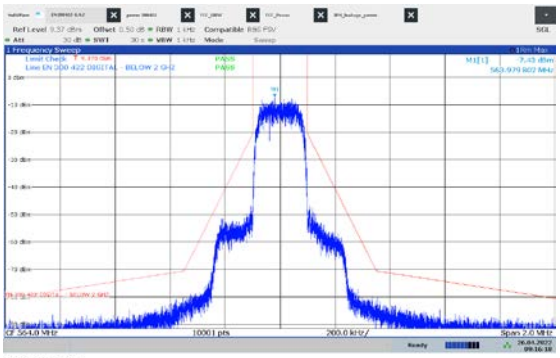
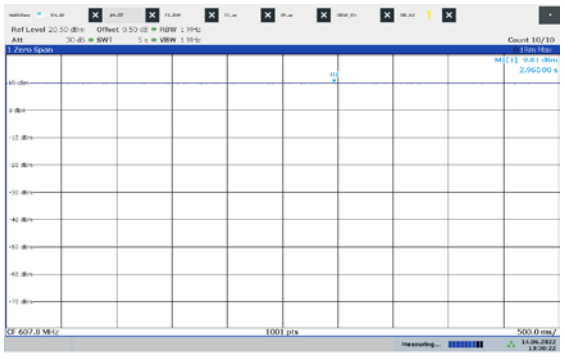
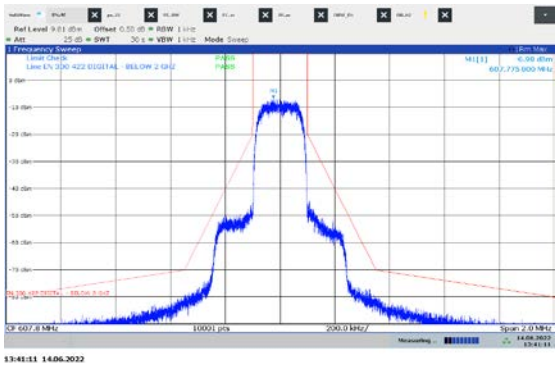
Measurement parameter	
Detector:	Peak / Average (-90 dBc point only)
Sweep time:	Auto
Resolution bandwidth:	1 kHz
Video bandwidth:	1 kHz
Span:	fc - 1 MHz to fc + 1 MHz (2 MHz)
Trace mode:	Max hold/view
EUT:	CW and MC
Test setup:	See sub clause 7.2 - D
Measurement uncertainty:	See sub clause 9

Limits: according to ETSI EN 300 422-1 v1.4.2

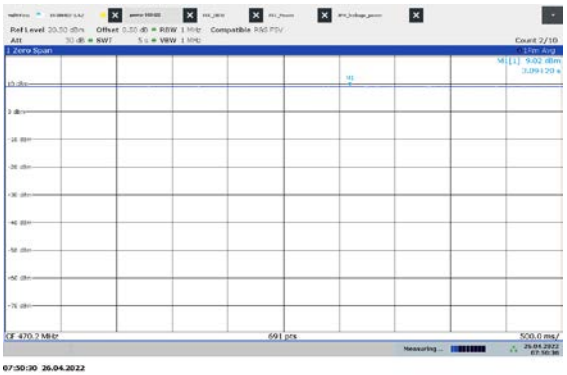
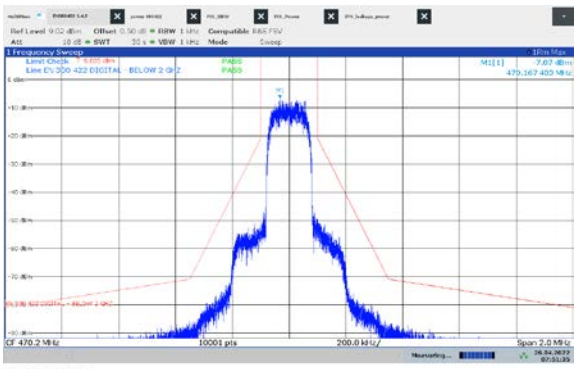
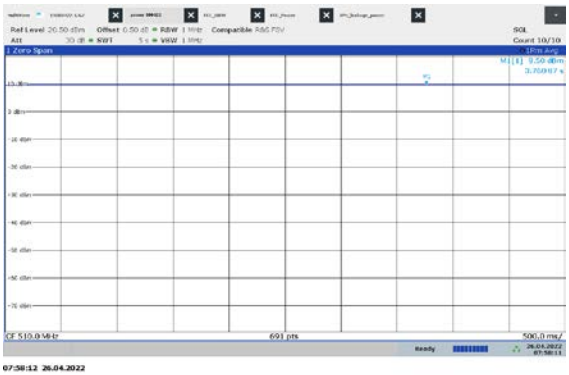
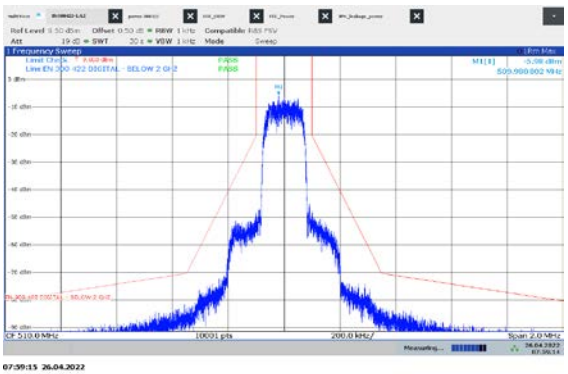
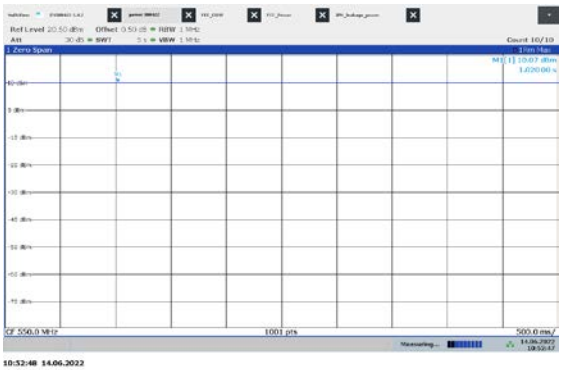
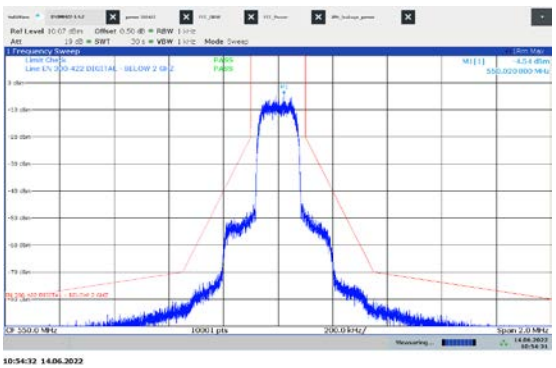
FCC & IC
Signal within the spectrum mask: 

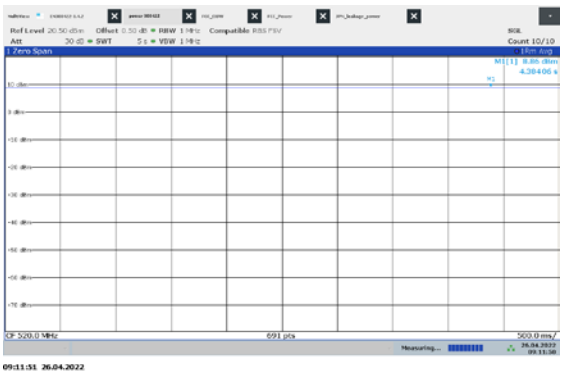
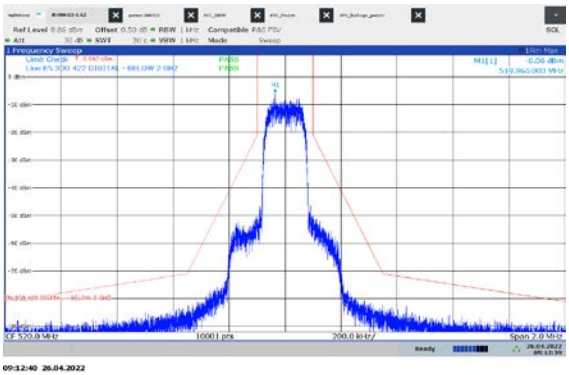
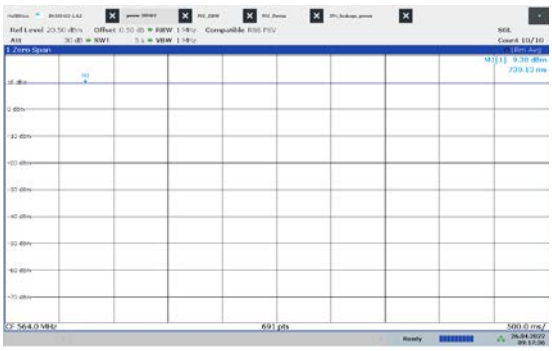
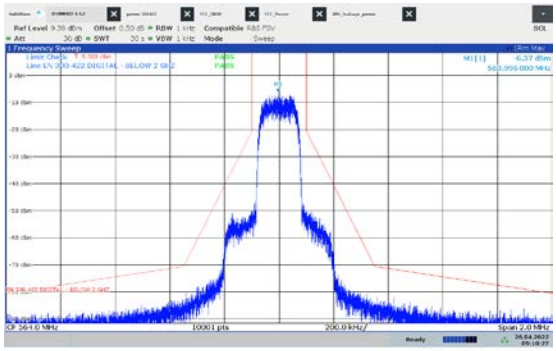
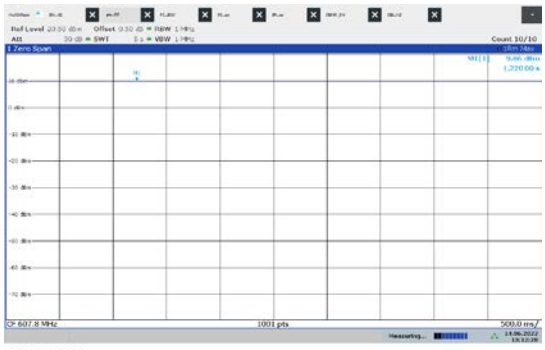
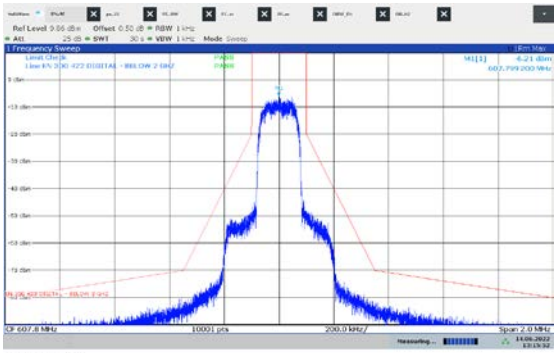
Plots normal mode:

Frequency	Carrier power	Modulated carrier with modulated carrier
470.2 MHz		
510.0 MHz		
550.0 MHz		

Frequency	Carrier power	Modulated carrier with modulated carrier
520.0 MHz		
564.0 MHz		
607.8 MHz		

Plots LD mode:

Frequency	Carrier power	Modulated carrier with modulated carrier
470.0 MHz		
510.0 MHz		
550.0 MHz		

Frequency	Carrier power	Modulated carrier with modulated carrier
520.0 MHz		
564.0 MHz		
607.8 MHz		

13 Observations

No observations except those reported with the single test cases have been made.

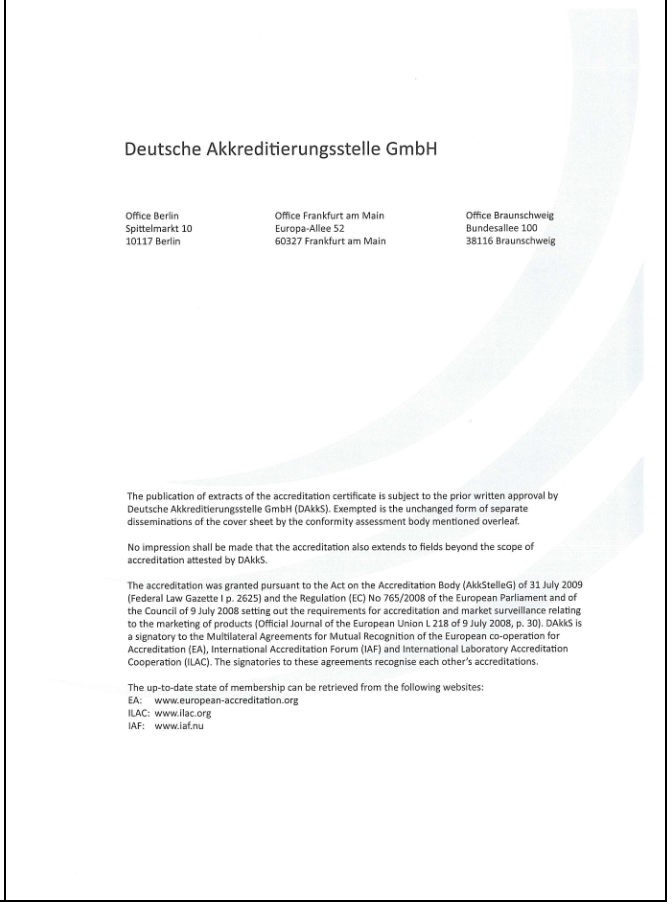
14 Glossary

EUT	Equipment under test
DUT	Device under test
UUT	Unit under test
GUE	GNSS User Equipment
ETSI	European Telecommunications Standards Institute
EN	European Standard
FCC	Federal Communications Commission
FCC ID	Company Identifier at FCC
IC	Industry Canada
PMN	Product marketing name
HMN	Host marketing name
HVIN	Hardware version identification number
FVIN	Firmware version identification number
EMC	Electromagnetic Compatibility
HW	Hardware
SW	Software
Inv. No.	Inventory number
S/N or SN	Serial number
C	Compliant
NC	Not compliant
NA	Not applicable
NP	Not performed
PP	Positive peak
QP	Quasi peak
AVG	Average
OC	Operating channel
OCW	Operating channel bandwidth
OBW	Occupied bandwidth
OOB	Out of band
DFS	Dynamic frequency selection
CAC	Channel availability check
OP	Occupancy period
NOP	Non occupancy period
DC	Duty cycle
PER	Packet error rate
CW	Clean wave
MC	Modulated carrier
WLAN	Wireless local area network
RLAN	Radio local area network
DSSS	Dynamic sequence spread spectrum
OFDM	Orthogonal frequency division multiplexing
FHSS	Frequency hopping spread spectrum
GNSS	Global Navigation Satellite System
C/N_0	Carrier to noise-density ratio, expressed in dB-Hz

15 Document history

Version	Applied changes	Date of release
-/-	Initial release	2022-07-15

16 Accreditation Certificate – D-PL-12076-01-04

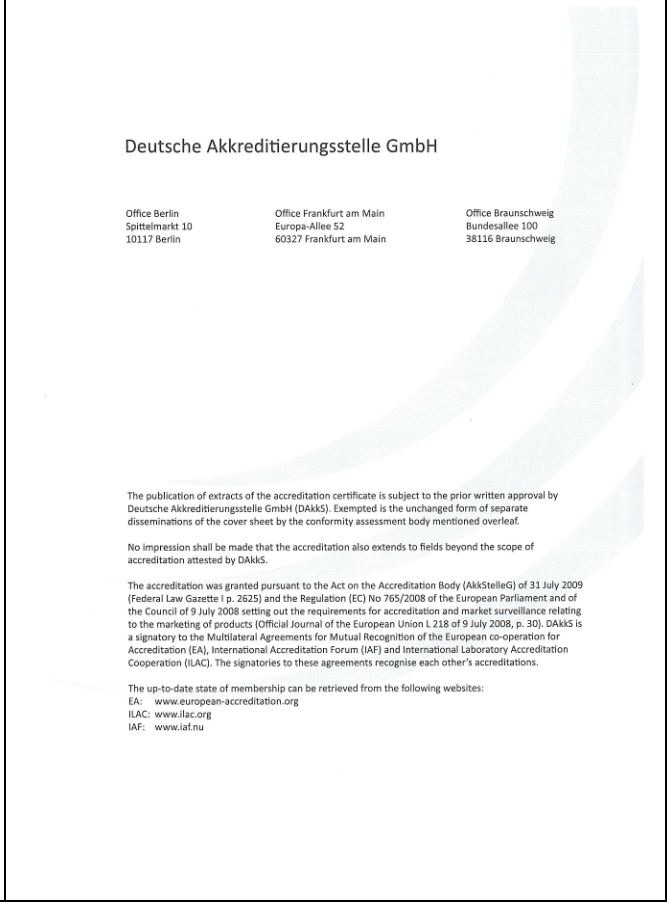
first page	last page
	

Note: The current certificate annex is published on the websites (link see below).

https://www.dakks.de/files/data/as/pdf/D-PL-12076-01-04e.pdf

or
https://ctcadvanced.com/app/uploads/2020/06/D-PL-12076-01-04_Canada_TCEMC.pdf

17 Accreditation Certificate – D-PL-12076-01-05

first page	last page
	

DAkkS Deutsche Akkreditierungsstelle

Deutsche Akkreditierungsstelle GmbH

Entrusted according to Section 8 subsection 1 AkkStelleG in connection with Section 1 subsection 1 AkkStelleGBV
Signatory to the Multilateral Agreements of EA, ILAC and IAF for Mutual Recognition

Accreditation

The Deutsche Akkreditierungsstelle GmbH attests that the testing laboratory

CTC advanced GmbH
Untertürkheimer Straße 6-10, 66117 Saarbrücken

is competent under the terms of DIN EN ISO/IEC 17025:2018 to carry out tests in the following fields:

Telecommunication (FCC Requirements)

The accreditation certificate shall only apply in connection with the notice of accreditation of 09.06.2020 with the accreditation number D-PL-12076-01. It comprises the cover sheet, the reverse side of the cover sheet and the following annex with a total of 05 pages.

Registration number of the certificate: **D-PL-12076-01-05**

Frankfurt am Main, 09.06.2020

by order Dipl.-Ing. (FH) Ralf Egner
Head of Division

The certificate together with its annex reflects the status at the time of the date of issue. The current status of the scope of accreditation can be found in the database of accredited bodies of Deutsche Akkreditierungsstelle GmbH.
https://www.dakks.de/en/content/accredited-bodies-dakks

See notes overleaf.

Deutsche Akkreditierungsstelle GmbH

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38116 Braunschweig

The publication of extracts of the accreditation certificate is subject to the prior written approval by Deutsche Akkreditierungsstelle GmbH (DAkkS). Exempted is the unchanged form of separate disseminations of the cover sheet by the conformity assessment body mentioned overleaf.

No impression shall be made that the accreditation also extends to fields beyond the scope of accreditation attested by DAkkS.

The accreditation was granted pursuant to the Act on the Accreditation Body (AkkStelleG) of 31 July 2009 (Federal Law Gazette I p. 2625) and the Regulation (EC) No 765/2008 of the European Parliament and of the Council of 9 July 2008 setting out the requirements for accreditation and market surveillance relating to the marketing of products (Official Journal of the European Union L 218 of 9 July 2008, p. 30). DAkkS is a signatory to the Multilateral Agreements for Mutual Recognition of the European co-operation for Accreditation (EA), International Accreditation Forum (IAF) and International Laboratory Accreditation Cooperation (ILAC). The signatories to these agreements recognise each other's accreditations.

The up-to-date state of membership can be retrieved from the following websites:
EA: www.european-accreditation.org
ILAC: www.ilac.org
IAF: www.iaf.nu

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https://www.dakks.de/files/data/as/pdf/D-PL-12076-01-05e.pdf

or

https://ctcadvanced.com/app/uploads/2020/06/D-PL-12076-01-05_TCB_USA.pdf

################################ END OF TEST REPORT ################################